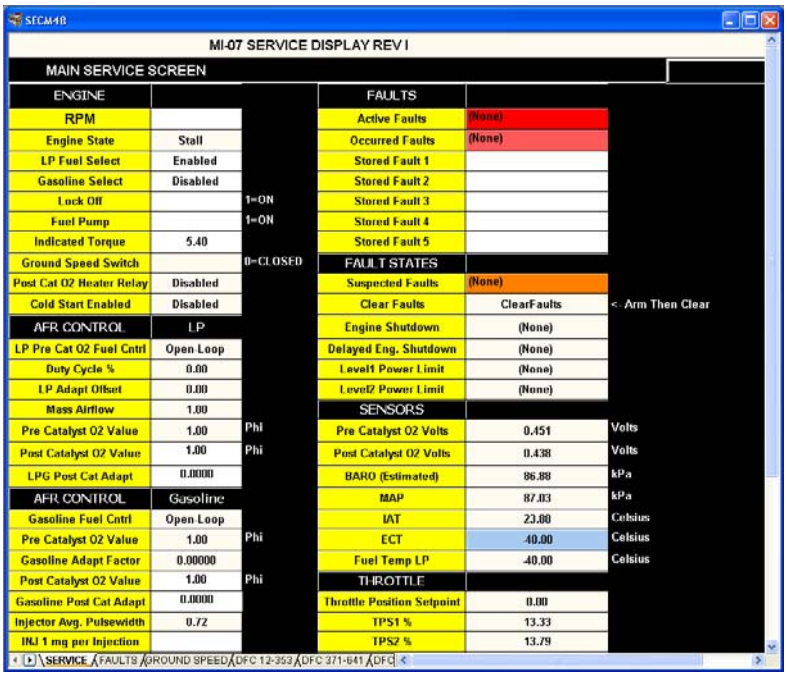
WOODWARD

User Manual



MI-07 Service Tool User Manual

Using the MotoView Display File for Diagnostics

Manual 36539

WARNING—DANGER OF DEATH OR PERSONAL INJURY

WARNING—FOLLOW INSTRUCTIONS

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.

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WARNING—OVERSPEED PROTECTION

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

WARNING—PROPER USE

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

CAUTION—POSSIBLE DAMAGE TO EQUIPMENT OR PROPERTY

CAUTION—BATTERY CHARGING

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

CAUTION—ELECTROSTATIC DISCHARGE

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts.

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

IMPORTANT DEFINITIONS

- **A WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**
- **A CAUTION indicates a potentially hazardous situation which, if not avoided, could result in damage to equipment or property.**
- **A NOTE provides other helpful information that does not fall under the warning or caution categories.**

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Chapter 1.
Introduction

The MI-07 Service Tool is a graphic interface to the SECM (Small Engine Control Module) and is made up of several screens to aid the technician in system diagnostics using a personal computer. The software application that is used to connect to the SECM is MotoView and is described in the next section. Once MotoView is connected to the SECM through the CAN cable a display file is opened (MI_07RevJ.dis) to display the available diagnostic features. The use of these features is described in **Chapter 3**.

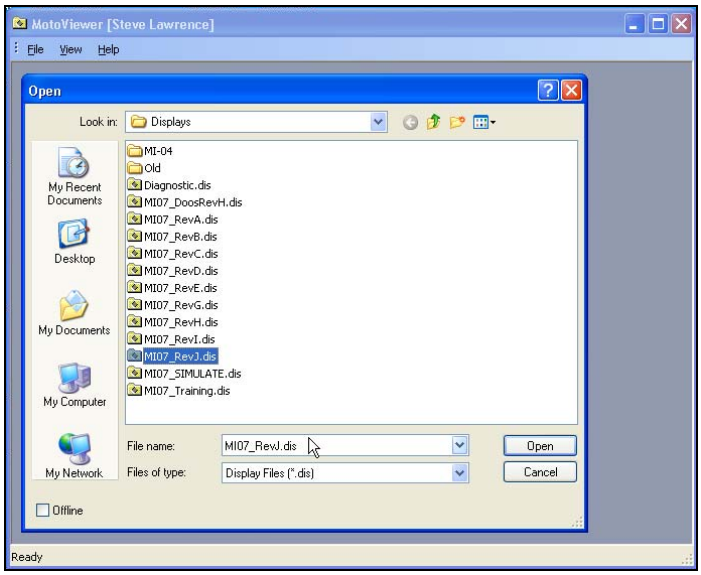


Figure 1. Opening MotoView Software

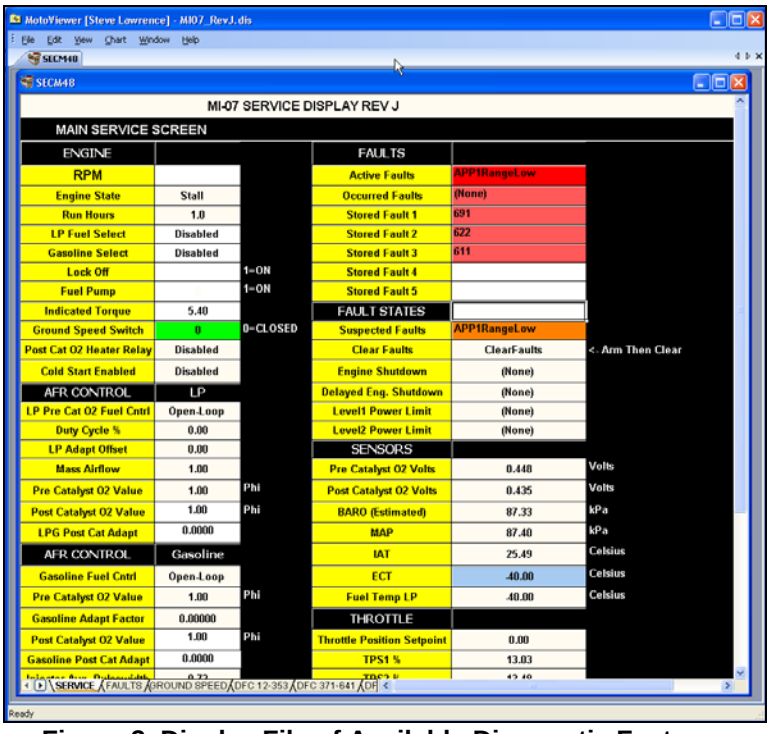


Figure 2. Display File of Available Diagnostic Features

Chapter 2.
Connection of the Service Tool

To use the Service Tool, a USB (Universal Serial Bus) to CAN (Controller Area Network) communication adapter by KVaser will be required along with a Crypt Token (**Figure 3**). The Crypt Token acts as a security key allowing the laptop to retrieve the necessary data from the SECM.

1. Install the Crypt Token in an available USB port in the computer (**Figure 4**).
2. With the ignition key in the OFF position, connect the KVaser communication cable from a second USB port on the computer to the CAN communications cable on the engine. *(*If your laptop computer does not have a second USB port an appropriate USB hub will need to be used).*
3. Connect a timing light to the engine.
4. Turn the ignition key to the ON position ***(Do Not Start the Engine)***.
5. Launch the MotoView program on your computer and open the Service Tool display (**Figure 5**).

Figure 3. KVaser Communication Adapter

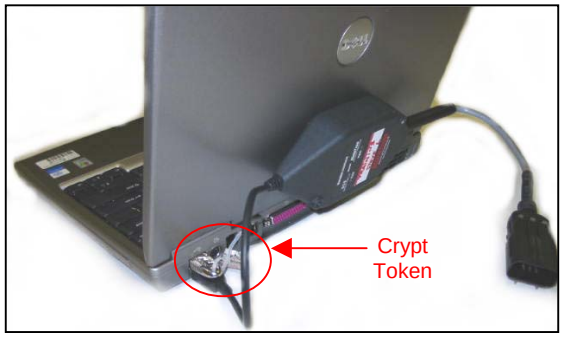


Figure 4. Crypt Token Installed on Laptop

Figure 5. Opening the Service Tool Display

Chapter 3.
MotoView Display Screens

Service Screen Tab

The first screen displayed when connecting to the SECM-48 is the Main Service Screen. The screen format is designed to give the technician a quick reference to the state of the MI-07 system and the engine. Main sections of this screen include the Engine category, Faults, Fault States, AFR Control, Sensors, Throttle, Accelerator Pedal, and Ignition.

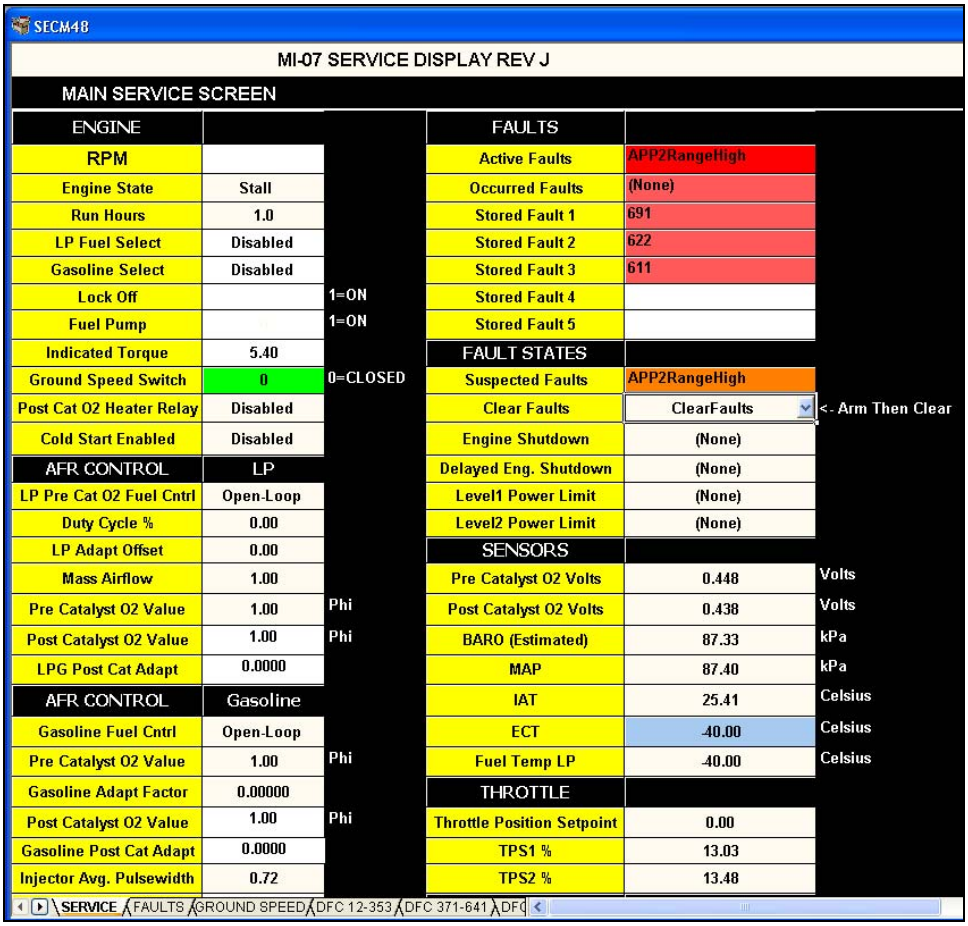


Figure 6 Main Service Screen

ENGINE

This category displays the engine RPM, one of three engine states (Stall, Crank, Run) and the selected fuel type. Engine run hours are also displayed in this category directly below the engine state. If the LPG fuel lock off or liquid fuel pump is active the adjacent data box will display a “1” meaning the device is on and the data box will turn green. Brief parameter notes are listed to the right of the parameter filed throughout the display screens. The indicated Torque parameter will inform you as to the amount of load placed on the engine and the Ground Speed Switch parameter displays the switch on or off, again the box will turn green if the switch is closed. The engine category also displays the status of the post O2 sensor heater replay and the cold start circuit.

AFR (AIR FUEL RATIO) CONTROL
The AFR Control category is divided into two separate sections, one for LP and a second for Gasoline, (active on bi-fuel units). Key parameters for AFR Control include the “Open-Loop”/ “Closed-Loop” control listing. This description informs the technician whether the emission system is using closed loop feedback from the oxygen sensors to control the AFR delivered to the exhaust catalyst or using tables in the engine control module for AFR control in open loop mode.

Both the pre catalyst (pre-CAT) and post catalyst (post-CAT) oxygen sensor setpoint values are displayed in Phi along with adaptive learn values. When in LP mode the FTV (Fuel Trim Valves) duty cycle is displayed in percent. If the system is running rich in closed loop, the duty cycle will increase to lean out the LP mixture to the engine. When in Gasoline operation the average fuel injector pulse width is displayed along with each individual fuel injector signal.

FAULTS
A brief fault list is displayed in the Fault category. Active faults display the description of all active faults—faults that are actively taking place when connected to the SECM. Occurred faults display the description of all stored faults. The first five stored faults of the ten possible fault stored record are displayed by the three digit fault codes. Definitions of these fault codes can be located on the DFC screens.

FAULT STATES
Suspected possible faults are displayed here. (These may be redundant of the occurred fault list.) All faults can be cleared from the Clear Faults pull down parameter. Place your mouse pointer over the Clear Fault parameter box, then simply click the pull down arrow and select the Arm option. You have now armed the clear fault function. Using your mouse click the pull down arrow again and select the ClearFaults option. You must select another area on the screen by clicking that area with your mouse to complete the Clear Faults function; you will then see all faults clear. Any faults that are active will immediately be stored in the fault record. Different fault actions such as engine shutdown are also listed in this category. Any fault that causes one of these actions will be displayed next to the action itself. Only one fault at a time will be displayed next to the fault action.

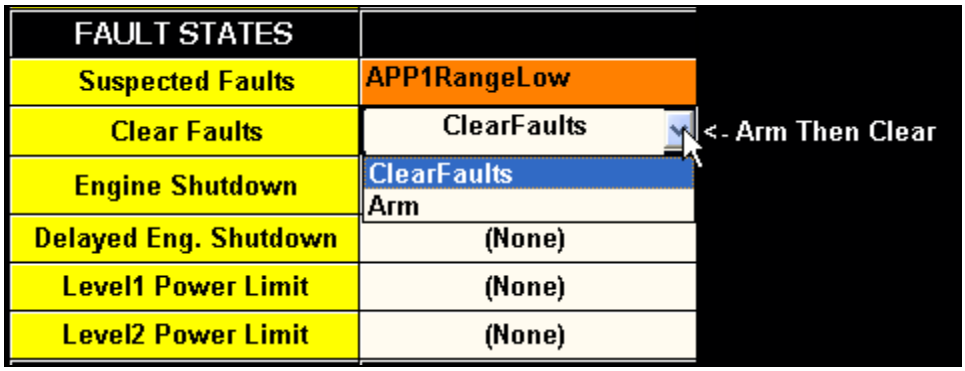


Figure 7 Clearing Faults

SENSORS
Key sensor values are displayed in this category. Oxygen sensor values have been converted to voltage for easier troubleshooting using a multi-meter. ECT (Engine Coolant Temperature) will turn green when the correct engine operating temperature is reached (75°C [167°F]).

THROTTLE
The throttle category displays the throttle setpoint, which is the value the SECM is trying to control the throttle to. TPS (Throttle Position Sensor) 1 & 2 values are also displayed in percent.

ACCELERATOR PEDAL
APP (Accelerator Pedal Position sensor) 1&2 values are displayed in percent.

IGNITION
Camshaft and crankshaft sensor synchronization is displayed along with a designator for the spark enable and the actual spark dwell.

Faults Screen Tab

The second available screen in the service tool display is the Fault screen. All ten stored fault codes are displayed in order of their occurrence. If a fault occurs and is stored it will not be stored again in the fault record until the fault has been cleared. This prevents the same re-occurring fault from being saved to all the stored records. Stored faults do not contain any type of date or time stamp to indicate when they occurred.

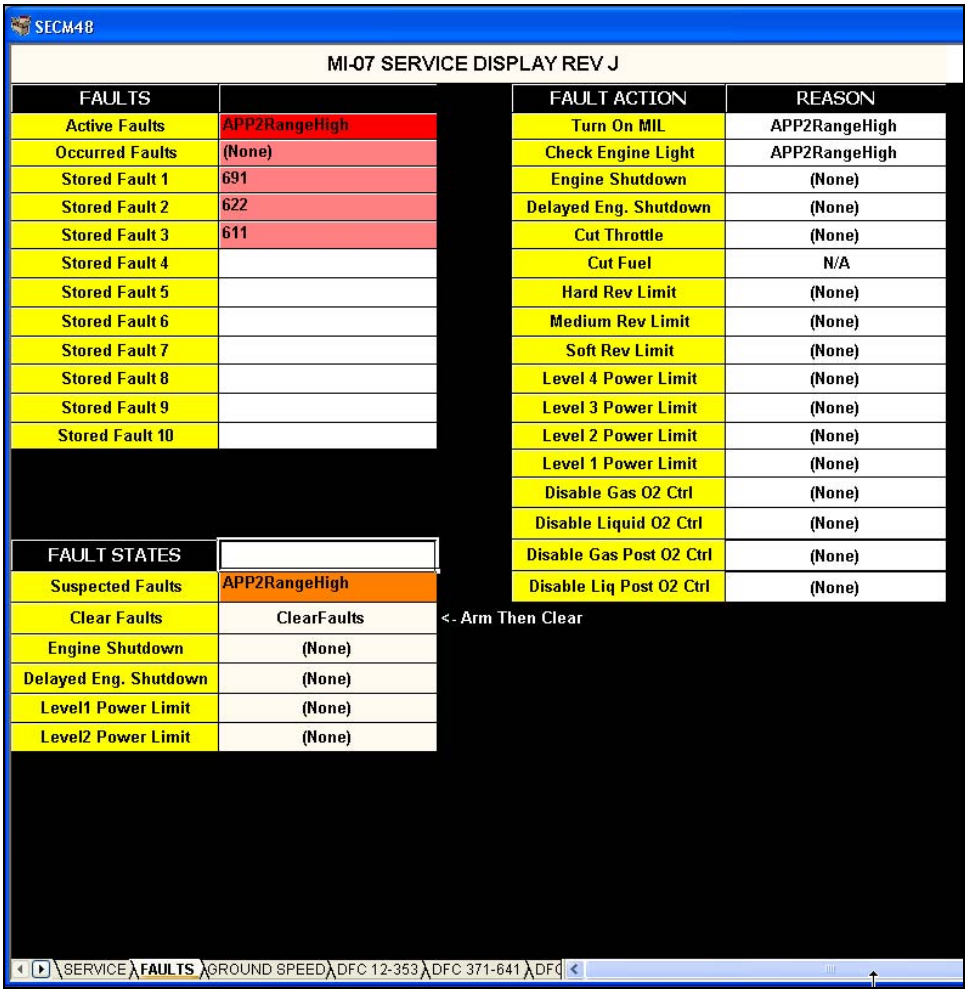


Figure 8. Faults Screen

FAULTS
Faults are displayed in the Fault category. Active faults display the description of all active faults, faults that are actively taking place when connected to the SECM. Occurred faults displays the description of all stored faults. The ten stored fault records are displayed by the three digit fault codes. Definitions of these fault codes can be located on the DFC screens.

FAULT STATES
Suspected possible faults are displayed here. (These may be redundant of the occurred fault list.) All faults can be cleared from the Clear Faults pull down parameter. Place your mouse pointer over the Clear Fault parameter box, then simply click the pull down arrow and select the Arm option (**Figure 7**). You have now armed the clear fault function. Using your mouse click the pull down arrow again and select the ClearFaults option. You must select another area on the screen by clicking that area with your mouse to complete the Clear Faults function; you will then see all faults clear. Any faults that are active will immediately be stored in the fault record. Different fault actions such as engine shutdown are also listed in this category. Any fault that causes one of these actions will be displayed next to the action itself. Only one fault at a time will be displayed next to the fault action.

FAULT ACTION
A list of possible fault actions is provided. Any fault that may induce one of these actions will be displayed next to the action.

Ground Speed Screen Tab

The Ground Speed screen displays parameters for the ground speed option. The Engine category of this screen gives the technician a quick reference of the engine state when making setpoint changes without having to switch screens. See the Service Screen display definitions for parameter explanations. If not used the Ground Speed Switch indicator will be open and the High Max RPM setpoint will still be active. See below for description.

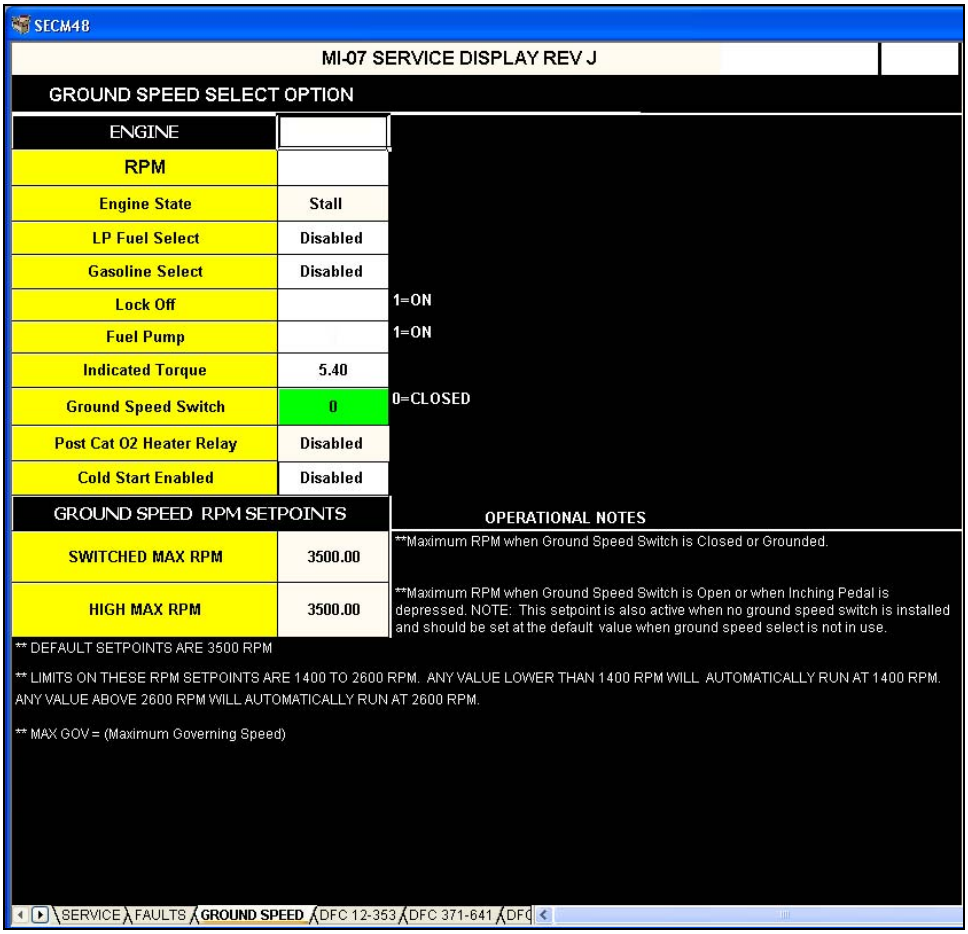
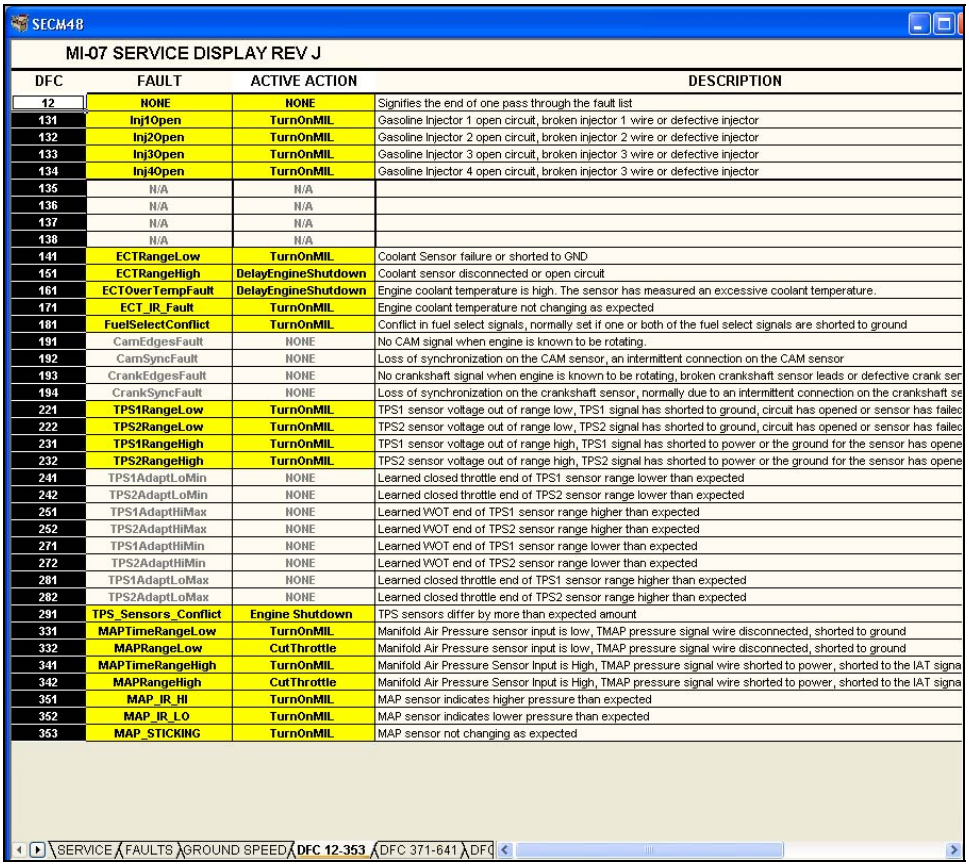

SECM48
MI-07 SERVICE DISPLAY REV J
GROUND SPEED SELECT OPTION
ENGINE
RPM
Engine State
Stall
LP Fuel Select
Disabled
Gasoline Select
Disabled
Lock Off
1=ON
Fuel Pump
1=ON
Indicated Torque
5.40
Ground Speed Switch
0
0=CLOSED
Post Cat O2 Heater Relay
Disabled
Cold Start Enabled
Disabled
GROUND SPEED RPM SETPOINTS
OPERATIONAL NOTES
SWITCHED MAX RPM
3500.00
**Maximum RPM when Ground Speed Switch is Closed or Grounded.
HIGH MAX RPM
3500.00
**Maximum RPM when Ground Speed Switch is Open or when Inching Pedal is depressed. NOTE: This setpoint is also active when no ground speed switch is installed and should be set at the default value when ground speed select is not in use.
** DEFAULT SETPOINTS ARE 3500 RPM
** LIMITS ON THESE RPM SETPOINTS ARE 1400 TO 2600 RPM. ANY VALUE LOWER THAN 1400 RPM WILL AUTOMATICALLY RUN AT 1400 RPM. ANY VALUE ABOVE 2600 RPM WILL AUTOMATICALLY RUN AT 2600 RPM.
** MAX GOV = (Maximum Governing Speed)
SERVICE
FAULTS
GROUND SPEED
DFC 12-353
DFC 371-641

Figure 9. Ground Speed Screen

GROUND SPEED RPM SETPOINTS

The ground speed RPM setpoints are active values used by the SECM. Simply highlight these values and enter a new value from your laptop computer. These values will be saved and used by the SECM even after disconnecting from the SECM and closing the display screen. If the ground switch input is closed (grounded), the Switched MAX RPM value will be used by the SECM as the maximum RPM. If the ground switch is open or not used, the High MAX RPM value will be used by the SECM as the maximum RPM. There is a limit placed on these values, the range is (1400 RPM – 2600 RPM). Any number lower than 1400 will cause the SECM to control at a maximum of 1400 RPM, any number entered above 2600 RPM will cause the SECM to control at 2600 RPM. Normal maximum governing RPM is approximately 2600RPM so the default value of 3500 RPM will not limit engine RPM in any way. The setpoint box will turn red if any value below 3500 is entered; this is simply a visual indication for the technician that a number other than the default value is being used.

DFC 12-353 Screen Tab



SECM48

MI-07 SERVICE DISPLAY REV J

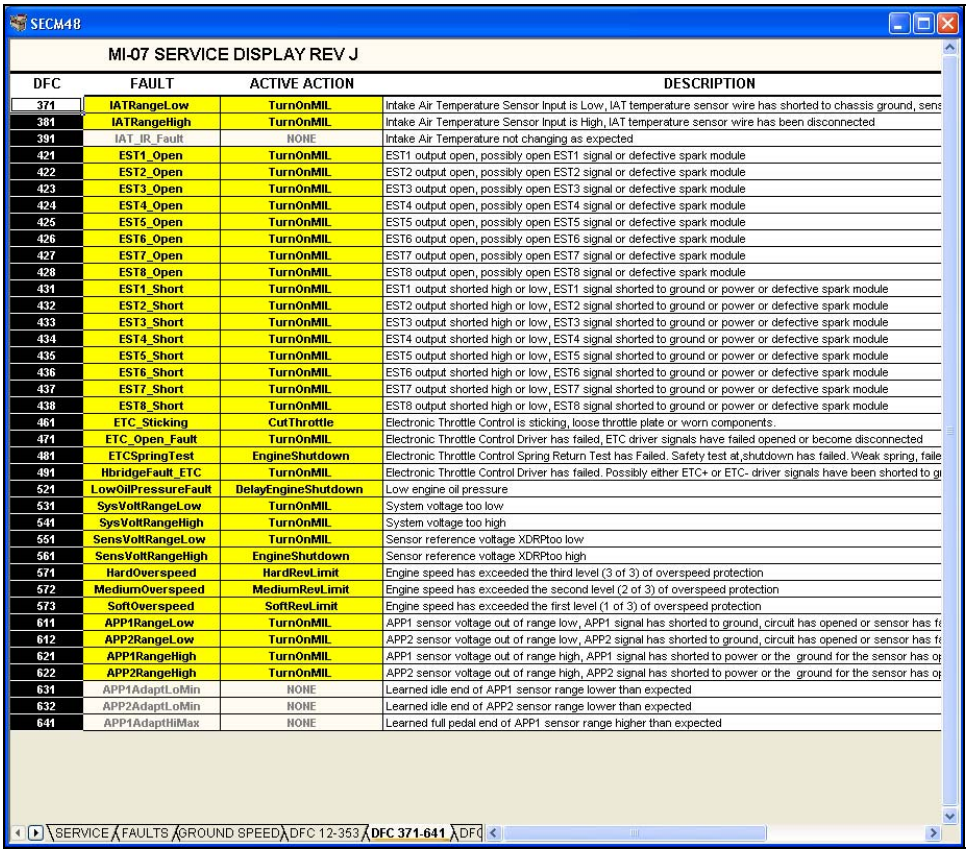
DFC	FAULT	ACTIVE ACTION	DESCRIPTION
12	NONE	NONE	Signifies the end of one pass through the fault list
131	Inj1Open	TurnOnMIL	Gasoline Injector 1 open circuit, broken injector 1 wire or defective injector
132	Inj2Open	TurnOnMIL	Gasoline Injector 2 open circuit, broken injector 2 wire or defective injector
133	Inj3Open	TurnOnMIL	Gasoline Injector 3 open circuit, broken injector 3 wire or defective injector
134	Inj4Open	TurnOnMIL	Gasoline Injector 4 open circuit, broken injector 3 wire or defective injector
135	N/A	N/A	
136	N/A	N/A	
137	N/A	N/A	
138	N/A	N/A	
141	ECTRangeLow	TurnOnMIL	Coolant Sensor failure or shorted to GND
151	ECTRangeHigh	DelayEngineShutdown	Coolant sensor disconnected or open circuit
161	ECTOverTempFault	DelayEngineShutdown	Engine coolant temperature is high. The sensor has measured an excessive coolant temperature.
171	ECT_IR_Fault	TurnOnMIL	Engine coolant temperature not changing as expected
181	FuelSelectConflict	TurnOnMIL	Conflict in fuel select signals, normally set if one or both of the fuel select signals are shorted to ground
191	CamEdgesFault	NONE	No CAM signal when engine is known to be rotating.
192	CamSyncFault	NONE	Loss of synchronization on the CAM sensor, an intermittent connection on the CAM sensor
193	CrankEdgesFault	NONE	No crankshaft signal when engine is known to be rotating, broken crankshaft sensor leads or defective crank ser
194	CrankSyncFault	NONE	Loss of synchronization on the crankshaft sensor, normally due to an intermittent connection on the crankshaft se
221	TPS1RangeLow	TurnOnMIL	TPS1 sensor voltage out of range low, TPS1 signal has shorted to ground, circuit has opened or sensor has failec
222	TPS2RangeLow	TurnOnMIL	TPS2 sensor voltage out of range low, TPS2 signal has shorted to ground, circuit has opened or sensor has failec
231	TPS1RangeHigh	TurnOnMIL	TPS1 sensor voltage out of range high, TPS1 signal has shorted to power or the ground for the sensor has opene
232	TPS2RangeHigh	TurnOnMIL	TPS2 sensor voltage out of range high, TPS2 signal has shorted to power or the ground for the sensor has opene
241	TPS1AdaptLoMin	NONE	Learned closed throttle end of TPS1 sensor range lower than expected
242	TPS2AdaptLoMin	NONE	Learned closed throttle end of TPS2 sensor range lower than expected
251	TPS1AdaptHiMax	NONE	Learned WOT end of TPS1 sensor range higher than expected
252	TPS2AdaptHiMax	NONE	Learned WOT end of TPS2 sensor range higher than expected
271	TPS1AdaptHiMin	NONE	Learned WOT end of TPS1 sensor range lower than expected
272	TPS2AdaptHiMin	NONE	Learned WOT end of TPS2 sensor range lower than expected
281	TPS1AdaptLoMax	NONE	Learned closed throttle end of TPS1 sensor range higher than expected
282	TPS2AdaptLoMax	NONE	Learned closed throttle end of TPS2 sensor range higher than expected
291	TPS_Sensors_Conflict	Engine Shutdown	TPS sensors differ by more than expected amount
331	MAPTimeRangeLow	TurnOnMIL	Manifold Air Pressure sensor input is low, TMAP pressure signal wire disconnected, shorted to ground
332	MAPRangeLow	CutThrottle	Manifold Air Pressure sensor input is low, TMAP pressure signal wire disconnected, shorted to ground
341	MAPTimeRangeHigh	TurnOnMIL	Manifold Air Pressure Sensor Input is High, TMAP pressure signal wire shorted to power, shorted to the IAT signa
342	MAPRangeHigh	CutThrottle	Manifold Air Pressure Sensor Input is High, TMAP pressure signal wire shorted to power, shorted to the IAT signa
351	MAP_IR_HI	TurnOnMIL	MAP sensor indicates higher pressure than expected
352	MAP_IR_LO	TurnOnMIL	MAP sensor indicates lower pressure than expected
353	MAP_STICKING	TurnOnMIL	MAP sensor not changing as expected

SERVICE | FAULTS | GROUND SPEED | DFC 12-353 | DFC 371-641 | DFC

Figure 10. Diagnostic Fault Codes 12-43 Screen

DFC (Diagnostic Fault Codes) 12 through 353 are defined on this display for quick reference. Faults that are displayed in yellow have been enabled on the MI-07 system. Faults that appear in grey are included for future use but are not enabled. Refer to the service manual or the Advanced Diagnostics section of this manual for repair steps and further troubleshooting.

DFC 371-641 Screen Tab

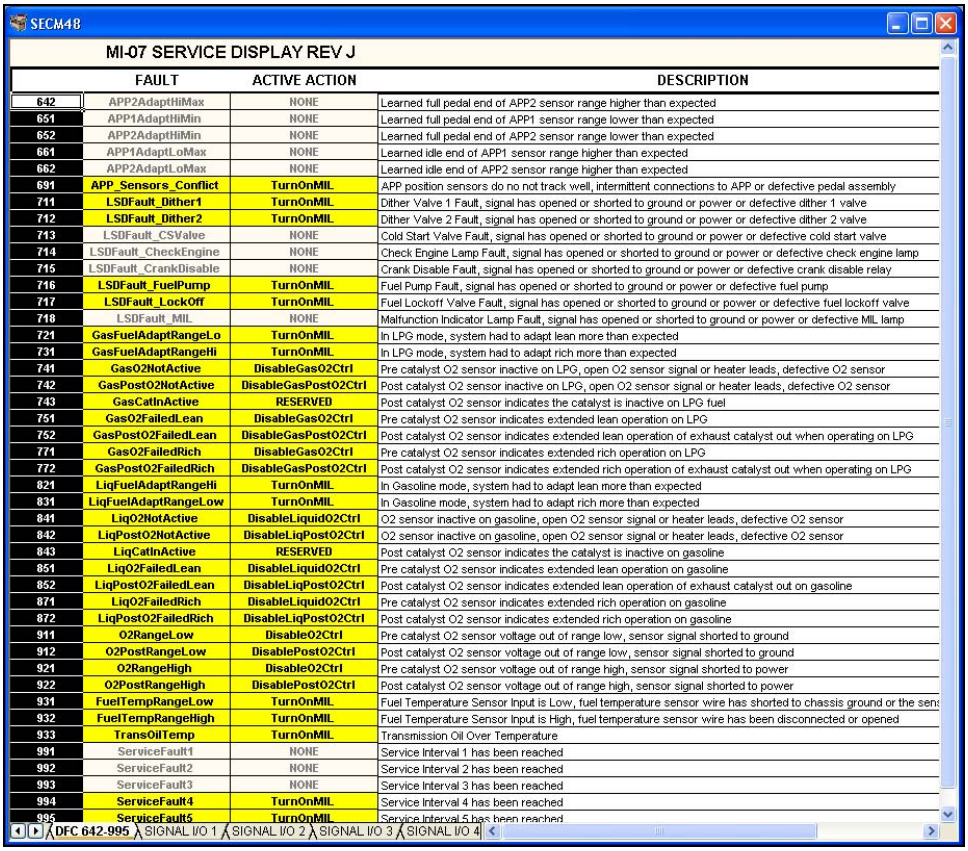


DFC	FAULT	ACTIVE ACTION	DESCRIPTION
371	IATRangeLow	TurnOnMIL	Intake Air Temperature Sensor Input is Low, IAT temperature sensor wire has shorted to chassis ground, sens
381	IATRangeHigh	TurnOnMIL	Intake Air Temperature Sensor Input is High, IAT temperature sensor wire has been disconnected
391	IAT_IR_Fault	NONE	Intake Air Temperature not changing as expected
421	EST1_Open	TurnOnMIL	EST1 output open, possibly open EST1 signal or defective spark module
422	EST2_Open	TurnOnMIL	EST2 output open, possibly open EST2 signal or defective spark module
423	EST3_Open	TurnOnMIL	EST3 output open, possibly open EST3 signal or defective spark module
424	EST4_Open	TurnOnMIL	EST4 output open, possibly open EST4 signal or defective spark module
425	EST5_Open	TurnOnMIL	EST5 output open, possibly open EST5 signal or defective spark module
426	EST6_Open	TurnOnMIL	EST6 output open, possibly open EST6 signal or defective spark module
427	EST7_Open	TurnOnMIL	EST7 output open, possibly open EST7 signal or defective spark module
428	EST8_Open	TurnOnMIL	EST8 output open, possibly open EST8 signal or defective spark module
431	EST1_Short	TurnOnMIL	EST1 output shorted high or low, EST1 signal shorted to ground or power or defective spark module
432	EST2_Short	TurnOnMIL	EST2 output shorted high or low, EST2 signal shorted to ground or power or defective spark module
433	EST3_Short	TurnOnMIL	EST3 output shorted high or low, EST3 signal shorted to ground or power or defective spark module
434	EST4_Short	TurnOnMIL	EST4 output shorted high or low, EST4 signal shorted to ground or power or defective spark module
435	EST5_Short	TurnOnMIL	EST5 output shorted high or low, EST5 signal shorted to ground or power or defective spark module
436	EST6_Short	TurnOnMIL	EST6 output shorted high or low, EST6 signal shorted to ground or power or defective spark module
437	EST7_Short	TurnOnMIL	EST7 output shorted high or low, EST7 signal shorted to ground or power or defective spark module
438	EST8_Short	TurnOnMIL	EST8 output shorted high or low, EST8 signal shorted to ground or power or defective spark module
461	ETC_Sticking	CutThrottle	Electronic Throttle Control is sticking, loose throttle plate or worn components.
471	ETC_Open_Fault	TurnOnMIL	Electronic Throttle Control Driver has failed, ETC driver signals have failed opened or become disconnected
481	ETCSpringTest	EngineShutdown	Electronic Throttle Control Spring Return Test has Failed. Safety test at,shutdown has failed. Weak spring, faile
491	HbridgeFault_ETC	TurnOnMIL	Electronic Throttle Control Driver has failed. Possibly either ETC+ or ETC- driver signals have been shorted to g
521	LowOilPressureFault	DelayEngineShutdown	Low engine oil pressure
531	SysVoltRangeLow	TurnOnMIL	System voltage too low
541	SysVoltRangeHigh	TurnOnMIL	System voltage too high
551	SensVoltRangeLow	TurnOnMIL	Sensor reference voltage XDRPtoo low
561	SensVoltRangeHigh	EngineShutdown	Sensor reference voltage XDRPtoo high
571	HardOverspeed	HardRevLimit	Engine speed has exceeded the third level (3 of 3) of overspeed protection
572	MediumOverspeed	MediumRevLimit	Engine speed has exceeded the second level (2 of 3) of overspeed protection
573	SoftOverspeed	SoftRevLimit	Engine speed has exceeded the first level (1 of 3) of overspeed protection
611	APP1RangeLow	TurnOnMIL	APP1 sensor voltage out of range low, APP1 signal has shorted to ground, circuit has opened or sensor has f
612	APP2RangeLow	TurnOnMIL	APP2 sensor voltage out of range low, APP2 signal has shorted to ground, circuit has opened or sensor has f
621	APP1RangeHigh	TurnOnMIL	APP1 sensor voltage out of range high, APP1 signal has shorted to power or the ground for the sensor has o
622	APP2RangeHigh	TurnOnMIL	APP2 sensor voltage out of range high, APP2 signal has shorted to power or the ground for the sensor has o
631	APP1AdaptLoMin	NONE	Learned idle end of APP1 sensor range lower than expected
632	APP2AdaptLoMin	NONE	Learned idle end of APP2 sensor range lower than expected
641	APP1AdaptHiMax	NONE	Learned full pedal end of APP1 sensor range higher than expected

Figure 11. Diagnostic Fault Codes 371-641 Screen

DFC (Diagnostic Fault Codes) 371 through 641 are defined on this display for quick reference. Faults that are displayed in yellow have been enabled on the MI-07 system. Faults that appear in grey are included for future use but are not enabled. Refer to the service manual or the Advanced Diagnostics section of this manual for repair steps and further troubleshooting.

DFC 642-995 Screen Tab



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MI-07 SERVICE DISPLAY REV J

	FAULT	ACTIVE ACTION	DESCRIPTION
642	APP2AdaptHiMax	NONE	Learned full pedal end of APP2 sensor range higher than expected
651	APP1AdaptHiMin	NONE	Learned full pedal end of APP1 sensor range lower than expected
652	APP2AdaptHiMin	NONE	Learned full pedal end of APP2 sensor range lower than expected
661	APP1AdaptLoMax	NONE	Learned idle end of APP1 sensor range higher than expected
662	APP2AdaptLoMax	NONE	Learned idle end of APP2 sensor range higher than expected
691	APP_Sensors_Conflict	TurnOnMIL	APP position sensors do no not track well, intermittent connections to APP or defective pedal assembly
711	LSDFault_Dither1	TurnOnMIL	Dither Valve 1 Fault, signal has opened or shorted to ground or power or defective dither 1 valve
712	LSDFault_Dither2	TurnOnMIL	Dither Valve 2 Fault, signal has opened or shorted to ground or power or defective dither 2 valve
713	LSDFault_CSValve	NONE	Cold Start Valve Fault, signal has opened or shorted to ground or power or defective cold start valve
714	LSDFault_CheckEngine	NONE	Check Engine Lamp Fault, signal has opened or shorted to ground or power or defective check engine lamp
715	LSDFault_CrankDisable	NONE	Crank Disable Fault, signal has opened or shorted to ground or power or defective crank disable relay
716	LSDFault_FuelPump	TurnOnMIL	Fuel Pump Fault, signal has opened or shorted to ground or power or defective fuel pump
717	LSDFault_LockOff	TurnOnMIL	Fuel Lockoff Valve Fault, signal has opened or shorted to ground or power or defective fuel lockoff valve
718	LSDFault_MIL	NONE	Malfunction Indicator Lamp Fault, signal has opened or shorted to ground or power or defective MIL lamp
721	GasFuelAdaptRangeLo	TurnOnMIL	In LPG mode, system had to adapt lean more than expected
731	GasFuelAdaptRangeHi	TurnOnMIL	In LPG mode, system had to adapt rich more than expected
741	GasO2NotActive	DisableGasO2Ctrl	Pre catalyst O2 sensor inactive on LPG, open O2 sensor signal or heater leads, defective O2 sensor
742	GasPostO2NotActive	DisableGasPostO2Ctrl	Post catalyst O2 sensor inactive on LPG, open O2 sensor signal or heater leads, defective O2 sensor
743	GasCatInActive	RESERVED	Post catalyst O2 sensor indicates the catalyst is inactive on LPG fuel
751	GasO2FailedLean	DisableGasO2Ctrl	Pre catalyst O2 sensor indicates extended lean operation on LPG
752	GasPostO2FailedLean	DisableGasPostO2Ctrl	Post catalyst O2 sensor indicates extended lean operation of exhaust catalyst out when operating on LPG
771	GasO2FailedRich	DisableGasO2Ctrl	Pre catalyst O2 sensor indicates extended rich operation on LPG
772	GasPostO2FailedRich	DisableGasPostO2Ctrl	Post catalyst O2 sensor indicates extended rich operation of exhaust catalyst out when operating on LPG
821	LiqFuelAdaptRangeHi	TurnOnMIL	In Gasoline mode, system had to adapt lean more than expected
831	LiqFuelAdaptRangeLow	TurnOnMIL	In Gasoline mode, system had to adapt rich more than expected
841	LiqO2NotActive	DisableLiquidO2Ctrl	O2 sensor inactive on gasoline, open O2 sensor signal or heater leads, defective O2 sensor
842	LiqPostO2NotActive	DisableLiqPostO2Ctrl	O2 sensor inactive on gasoline, open O2 sensor signal or heater leads, defective O2 sensor
843	LiqCatInActive	RESERVED	Post catalyst O2 sensor indicates the catalyst is inactive on gasoline
851	LiqO2FailedLean	DisableLiquidO2Ctrl	Pre catalyst O2 sensor indicates extended lean operation on gasoline
852	LiqPostO2FailedLean	DisableLiqPostO2Ctrl	Post catalyst O2 sensor indicates extended lean operation of exhaust catalyst out on gasoline
871	LiqO2FailedRich	DisableLiquidO2Ctrl	Pre catalyst O2 sensor indicates extended rich operation on gasoline
872	LiqPostO2FailedRich	DisableLiqPostO2Ctrl	Post catalyst O2 sensor indicates extended rich operation on gasoline
911	O2RangeLow	DisableO2Ctrl	Pre catalyst O2 sensor voltage out of range low, sensor signal shorted to ground
912	O2PostRangeLow	DisablePostO2Ctrl	Post catalyst O2 sensor voltage out of range low, sensor signal shorted to ground
921	O2RangeHigh	DisableO2Ctrl	Pre catalyst O2 sensor voltage out of range high, sensor signal shorted to power
922	O2PostRangeHigh	DisablePostO2Ctrl	Post catalyst O2 sensor voltage out of range high, sensor signal shorted to power
931	FuelTempRangeLow	TurnOnMIL	Fuel Temperature Sensor Input is Low, fuel temperature sensor wire has shorted to chassis ground or the sens
932	FuelTempRangeHigh	TurnOnMIL	Fuel Temperature Sensor Input is High, fuel temperature sensor wire has been disconnected or opened
933	TransOilTemp	TurnOnMIL	Transmission Oil Over Temperature
991	ServiceFault1	NONE	Service Interval 1 has been reached
992	ServiceFault2	NONE	Service Interval 2 has been reached
993	ServiceFault3	NONE	Service Interval 3 has been reached
994	ServiceFault4	TurnOnMIL	Service Interval 4 has been reached
995	ServiceFault5	TurnOnMIL	Service Interval 5 has been reached

DFC 642-995 | SIGNAL I/O 1 | SIGNAL I/O 2 | SIGNAL I/O 3 | SIGNAL I/O 4

Figure 12. Diagnostic Fault Codes 642-995 Screen

DFC (Diagnostic Fault Codes) 642 through 995 are defined on this display for quick reference. Faults that are displayed in yellow have been enabled on the MI-07 system. Faults that appear in grey are included for future use but are not enabled. Refer to the service manual or the Advanced Diagnostics section of this manual for repair steps and further troubleshooting.

Signal I/O Screens 1-4

There are four Signal I/O (Inputs & Outputs) screens available to assist in troubleshooting. Each screen will display SECM inputs and outputs to the various system sensors, solenoids, relays and drivers. Components are listed in categories with the signal names, values and SECM pin location. A pin out of each sensor is given along with the signal type and the corresponding SECM pin connection. System power and sensor power is actively displayed in red or orange. Ground connections are displayed in grey.

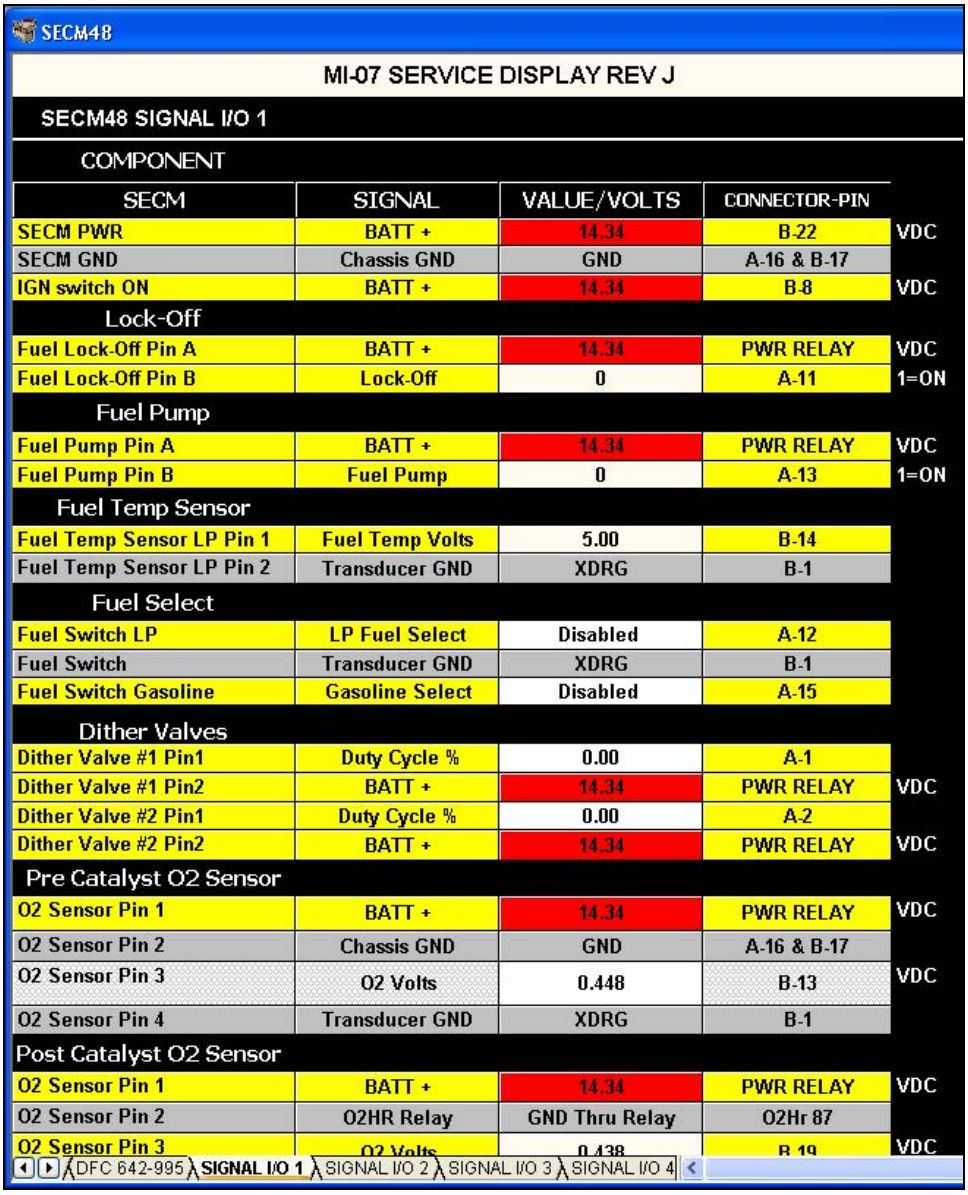

SECM48
MI-07 SERVICE DISPLAY REV J
SECM48 SIGNAL I/O 1
COMPONENT
SECM | SIGNAL | VALUE/VOLTS | CONNECTOR-PIN
SECM PWR | BATT + | 14.34 | B-22 | VDC
SECM GND | Chassis GND | GND | A-16 & B-17
IGN switch ON | BATT + | 14.34 | B-8 | VDC
Lock-Off
Fuel Lock-Off Pin A | BATT + | 14.34 | PWR RELAY | VDC
Fuel Lock-Off Pin B | Lock-Off | 0 | A-11 | 1=ON
Fuel Pump
Fuel Pump Pin A | BATT + | 14.34 | PWR RELAY | VDC
Fuel Pump Pin B | Fuel Pump | 0 | A-13 | 1=ON
Fuel Temp Sensor
Fuel Temp Sensor LP Pin 1 | Fuel Temp Volts | 5.00 | B-14
Fuel Temp Sensor LP Pin 2 | Transducer GND | XDRG | B-1
Fuel Select
Fuel Switch LP | LP Fuel Select | Disabled | A-12
Fuel Switch | Transducer GND | XDRG | B-1
Fuel Switch Gasoline | Gasoline Select | Disabled | A-15
Dither Valves
Dither Valve #1 Pin1 | Duty Cycle % | 0.00 | A-1
Dither Valve #1 Pin2 | BATT + | 14.34 | PWR RELAY | VDC
Dither Valve #2 Pin1 | Duty Cycle % | 0.00 | A-2
Dither Valve #2 Pin2 | BATT + | 14.34 | PWR RELAY | VDC
Pre Catalyst O2 Sensor
O2 Sensor Pin 1 | BATT + | 14.34 | PWR RELAY | VDC
O2 Sensor Pin 2 | Chassis GND | GND | A-16 & B-17
O2 Sensor Pin 3 | O2 Volts | 0.448 | B-13 | VDC
O2 Sensor Pin 4 | Transducer GND | XDRG | B-1
Post Catalyst O2 Sensor
O2 Sensor Pin 1 | BATT + | 14.34 | PWR RELAY | VDC
O2 Sensor Pin 2 | O2HR Relay | GND Thru Relay | O2Hr 87
O2 Sensor Pin 3 | O2 Volts | 0.438 | B-19 | VDC
DFC 642-995 | SIGNAL I/O 1 | SIGNAL I/O 2 | SIGNAL I/O 3 | SIGNAL I/O 4

Figure 13. Signal I/O Screen 1

Manual Override Screens 1 & 2

There are two manual override screens available for the technician to test for failed components or to isolate problems during troubleshooting. Manual overrides can override normal system function regardless of engine state. Active, suspected and occurred faults are displayed on each override screen for quick reference along with the ability to clear all faults.

Manual Override Screen 1

Components that can be overridden on override screen 1 include the Main Power Relay, LP fuel Lock-off, Fuel Select Switch, Electric Fuel Pump (Bi-Fuel Units), Fuel Trim Valves, O2 Sensor, and the Cold Start Valve.

CAUTION
Be aware of fuel flow and ignition when performing any manual override of a system component as engine damage may result.

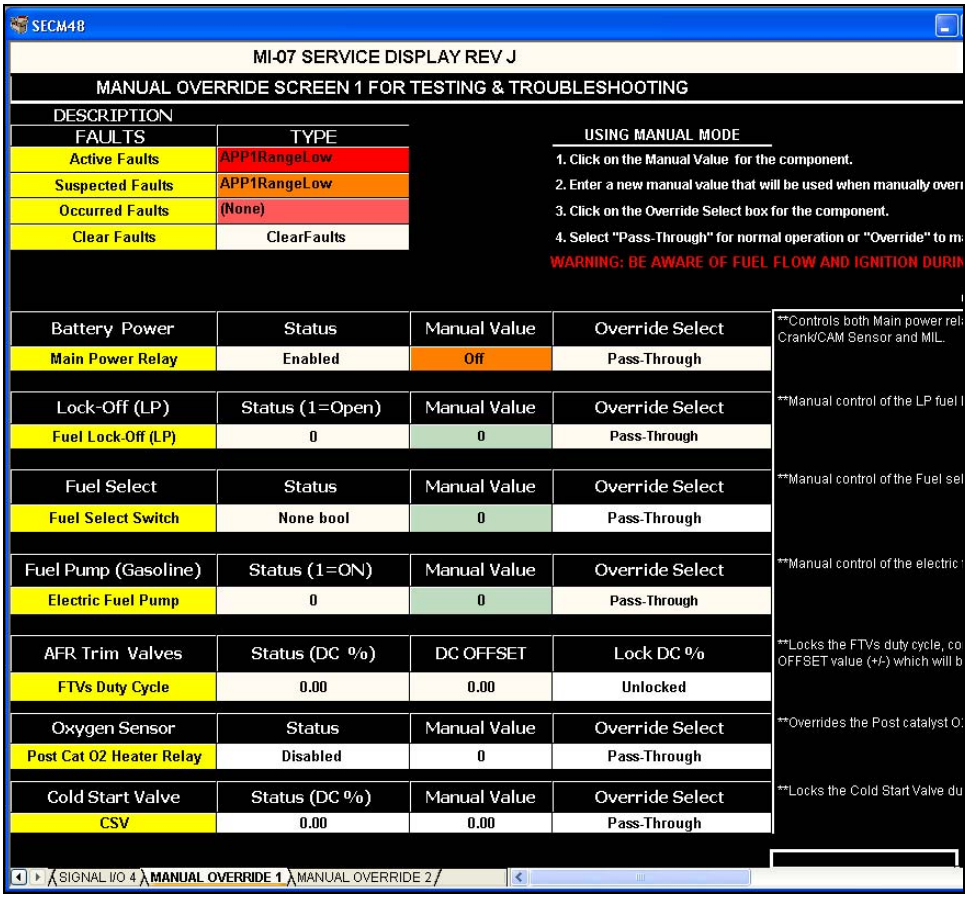

SECM48
MI-07 SERVICE DISPLAY REV J
MANUAL OVERRIDE SCREEN 1 FOR TESTING & TROUBLESHOOTING
DESCRIPTION
FAULTS
TYPE
Active Faults
APP1RangeLow
Suspected Faults
APP1RangeLow
Occurred Faults
(None)
Clear Faults
ClearFaults
USING MANUAL MODE
1. Click on the Manual Value for the component.
2. Enter a new manual value that will be used when manually overr
3. Click on the Override Select box for the component.
4. Select "Pass-Through" for normal operation or "Override" to m
WARNING: BE AWARE OF FUEL FLOW AND IGNITION DURI
Battery Power | Status | Manual Value | Override Select
Main Power Relay | Enabled | Off | Pass-Through
**Controls both Main power rel
Crank/CAM Sensor and MIL.
Lock-Off (LP) | Status (1=Open) | Manual Value | Override Select
Fuel Lock-Off (LP) | 0 | 0 | Pass-Through
**Manual control of the LP fuel
Fuel Select | Status | Manual Value | Override Select
Fuel Select Switch | None bool | 0 | Pass-Through
**Manual control of the Fuel sel
Fuel Pump (Gasoline) | Status (1=ON) | Manual Value | Override Select
Electric Fuel Pump | 0 | 0 | Pass-Through
**Manual control of the electric
AFR Trim Valves | Status (DC %) | DC OFFSET | Lock DC %
FTVs Duty Cycle | 0.00 | 0.00 | Unlocked
**Locks the FTVs duty cycle, co
OFFSET value (+/-) which will b
Oxygen Sensor | Status | Manual Value | Override Select
Post Cat O2 Heater Relay | Disabled | 0 | Pass-Through
**Overrides the Post catalyst O
Cold Start Valve | Status (DC %) | Manual Value | Override Select
CSV | 0.00 | 0.00 | Pass-Through
**Locks the Cold Start Valve du
SIGNAL I/O 4
MANUAL OVERRIDE 1
MANUAL OVERRIDE 2

Figure 14. Manual Override Screen 1

SWITCHED COMPONENTS
To override a switched state component such as the LP lock-off, enter the desired ON/OFF (1=On, 0=Off) in the Manual Value box. Place your mouse pointer over the Override Select parameter box, then simply click the pull down arrow and select the Override option. The SECM will now be overridden and the manual value will be used to either turn on or turn off the component. The

override select box will turn red when in manual override. To stop the override mode simply click the pull down arrow in the override select box and choose the “pass-through” option. Normal operation will resume. While in override you can change the manual value for ON/OFF and the component will react to the new value. Once the key switch is cycled ON then OFF, all manual overrides will return to normal operation (pass-through), regardless of the override state on the display screen.

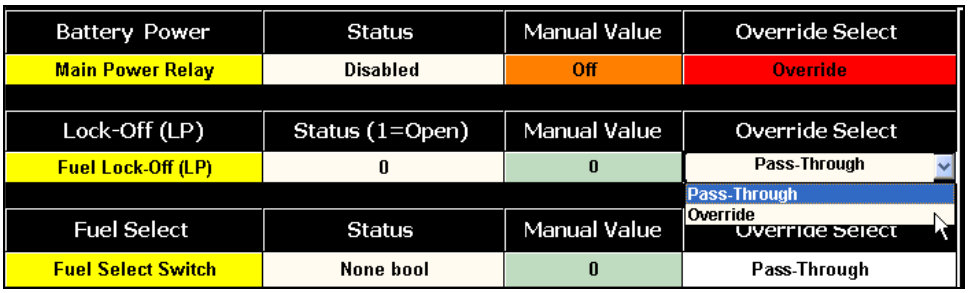


Figure 15. Overriding a Switched State Component

DC% COMPONENTS

To override a DC% (Duty Cycle%) component such as the FTVs, place your mouse pointer over the Lock DC% parameter box, then simply click the pull down arrow and select the “Locked” option. Enter the desired duty cycle in percent (0-100%) in the DC Offset box. This offset value will be added to the Status DC% value. For example: when locked the status value is 30%. If you wish to drive the component at 50% you would enter 20% in the DC Offset box (30%+20%=50%). The SECM will now be overridden and the manual value will be used to drive the component with a PWM (Pulse Width Modulated) signal. The Lock DC% box will turn red when in manual override or locked. To stop the override mode simply click the pull down arrow in the Lock DC% box and choose the “unlocked” option. Reset the DC offset to 0 % and normal operation will resume. While in override you can change the DC Offset duty cycle and the component will react to the new value. Once the key switch is cycled ON then OFF, all manual overrides will return to normal operation (pass-through) or (unlocked), regardless of the override stat on the display screen.

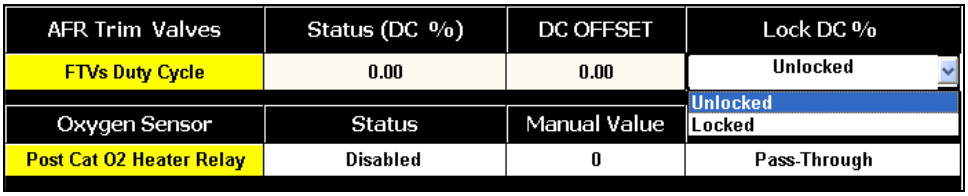


Figure 16. Overriding a Duty Cycle % Component

Components that can be overridden on override screen 2 include the Low Oil Pressure Switch, Transmission Temperature Switch, Ground Speed Switch, Spark Advance and the MIL. Four of the five selections are switched components with the exception of the manual Spark Advance.

MANUAL SPARK ADVANCE

To override the ignition spark advance place your mouse pointer over the Lock Spark Adv., parameter box, then simply click the pull down arrow and select the “Locked” option.

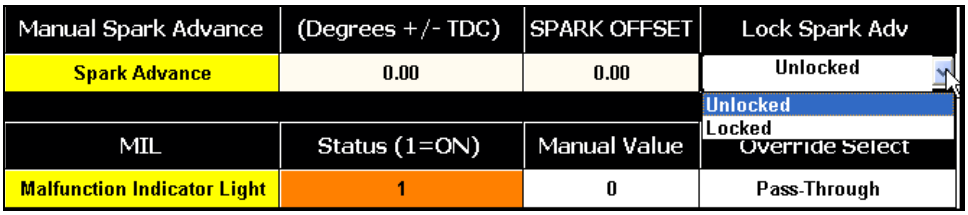


Figure 17. Overriding Ignition Spark Advance

Spark advance will be overridden and locked from the SECM. This locked spark advance value will be displayed in the (Degrees +/- TDC) box. Enter the desired spark advance in the Spark Offset box. This offset value will be added to the Spark (Degrees +/- TDC) value. For example: when locked the +/- TDC value is +8.0. If you wish to advance the spark to 10 degrees BTDC you would enter 2.0 in the Spark Offset box (8.0 + 2.0=10.0). The SECM control will now be overridden and the manual value will be used to set the spark advance through the SECM at the fixed value. The Lock Spark Adv., box will turn red when in manual override or locked. To stop the override mode simply click the pull down arrow in the Lock Spark Adv., box and choose the “unlocked” option. Reset the Spark offset to 0 and normal operation will resume. While in override you can change the Spark Offset and the ignition timing will react to the new value. Once the key switch is cycled ON then OFF, all manual overrides will return to normal operation (pass-through) or unlocked.

Manual Override Screen 2

Components that can be overridden on override screen 2 include the Low Oil Pressure Switch, Transmission Temperature Switch, Ground Speed Switch, Spark Advance, and the Malfunction Indicator Light (MIL).

CAUTION

Be aware of fuel flow and ignition when performing any manual override of a system component as engine damage may result.

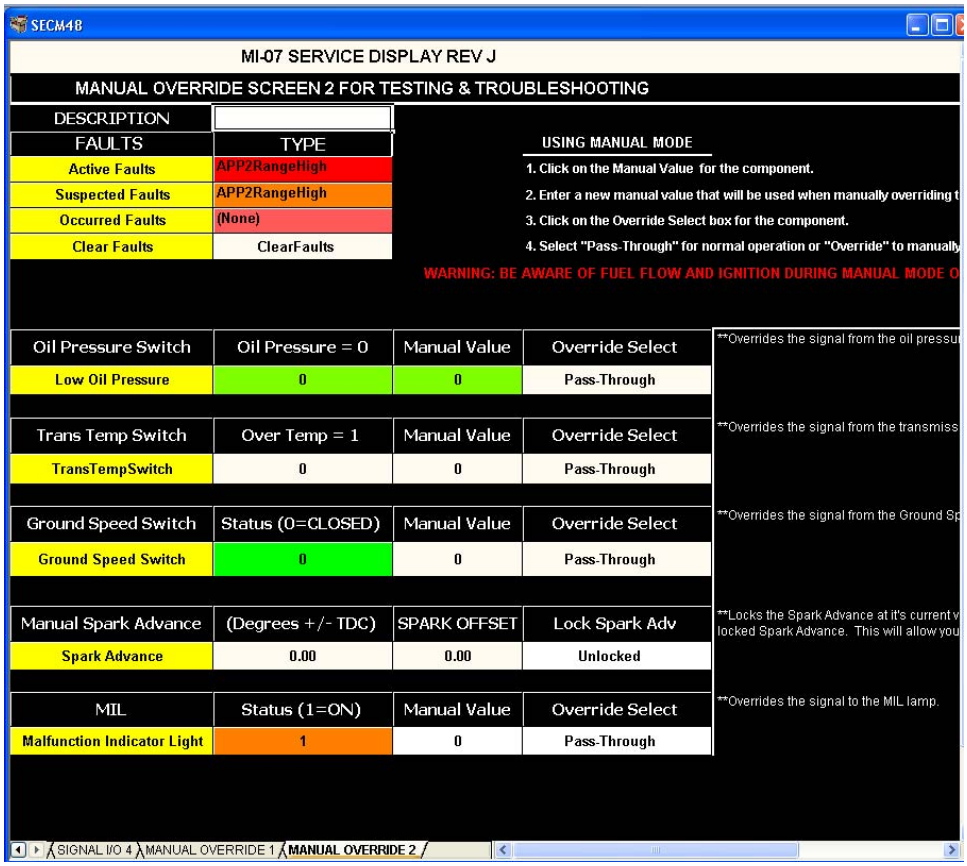


Figure 18. Manual Override Screen 2

Chapter 4.
Advanced Diagnostics

MI-07 systems are equipped with built-in fault diagnostics. Detected system faults can be displayed by the Malfunction Indicator Lamp (MIL) as Diagnostic Fault Codes (DFC) or flash codes, and viewed in detail with the use of the Service Tool software. When the ignition key is turned on, the MIL will illuminate and remain on until the engine is started. Once the engine is started, the MIL lamp will go out unless one or more fault conditions are present. If a detected fault condition exists, the fault or faults will be stored in the memory of the small engine control module (SECM). Once an active fault occurs the MIL will illuminate and remain ON. This signals the operator that a fault has been detected by the SECM.

Reading Diagnostic Fault Codes

All MI-07 fault codes are three-digit codes. When the fault codes are retrieved (displayed) the MIL will flash for each digit with a short pause (0.5 seconds) between digits and a long pause (1.2 seconds) between fault codes. A code 12 is displayed at the end of the code list.

EXAMPLE: A code 461 (ETCSticking) has been detected and the engine has shut down and the MIL has remained **ON**. When the codes are displayed the MIL will flash four times (**4**), pause, then flash six times (**6**), pause, then flash one time (**1**) This identifies a four sixty one (**461**), which is the ETCSticking fault. If any additional faults were stored, the SECM would again have a long pause, then display the next fault by flashing each digit. Since no other faults were stored there will be a long pause then one flash (**1**), pause, then two flashes (**2**). This identifies a twelve, signifying the end of the fault list. This list will then repeat.

Displaying Fault Codes (DFC) from SECM Memory

To enter code display mode you must turn **OFF** the ignition key. Now turn **ON** the key but do not start the engine. As soon as you turn the key to the ON position you must cycle the foot pedal by depressing it to the floor and then fully releasing the pedal (pedal maneuver). You must fully cycle the foot pedal three (**3**) times within five (**5**) seconds to enable the display codes feature of the SECM. Simply turn the key **OFF** to exit display mode. The code list will continue to repeat until the key is turned **OFF**.

Clearing Fault (DFC) Codes

To clear the stored fault codes from SECM memory you must complete the reset fault pedal maneuver.

CAUTION
Once the fault list is cleared it cannot be restored.

First turn **OFF** the ignition key. Now turn **ON** the key but do not start the engine. As soon as you turn the key to the ON position you must cycle the foot pedal by depressing it to the floor and then fully releasing the pedal (pedal maneuver). You must fully cycle the foot pedal ten (**10**) times within five (**5**) seconds to clear the fault code list of the SECM. Simply turn the key **OFF** to exit the reset mode.

The code list is now clear and the SECM will begin storing new fault codes as they occur.

Fault Action Descriptions

Each fault detected by the SECM is stored in memory (FIFO) and has a specific action or result that takes place. Listed below are the descriptions of each fault action.

Engine Shutdown: The most severe action is an Engine Shutdown. The MIL will light and the engine will immediately shutdown, stopping spark, closing the fuel lock-off closing, and turning off the fuel pump and fuel injectors.

Delayed Engine Shutdown: Some faults, such as low oil pressure, will cause the MIL to illuminate for 30 seconds and then shut down the engine.

Cut Throttle: The throttle moves to its default position. The engine will run at idle but will not accelerate.

Cut Fuel: Fuel flow will be turned off.

Turn on MIL: The MIL will light by an active low signal provided by the SECM, indicating a fault condition. May illuminate with no other action or may be combined with other actions, depending on which fault is active.

Soft Rev Limit / Medium Rev Limit / Hard Rev Limit: System will follow various sequences to bring engine speed back to acceptable levels.

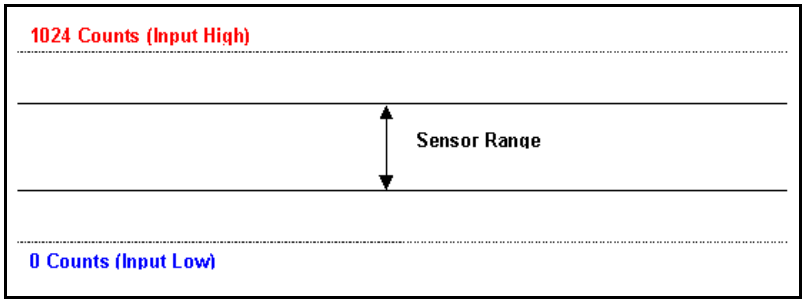
Level4 Power Limit / Level3 Power Limit / Level2 Power Limit / Level1 Power Limit: The maximum engine power output will be limited to one of four possible levels. The engine power is calculated from measured engine parameters (e.g. MAP, rpm, fuel flow, etc).

Disable Gas O2 Control: In LPG mode, closed loop correction of air fuel ratio based on the Pre-catalyst O2 sensor is disabled.

Disable Liquid O2 Control: In Gasoline mode, closed loop correction of air fuel ratio based on the Pre-catalyst O2 sensor is disabled.

Fault List Definitions

All the analog sensors in the MI-07 system have input sensor range faults. These are the coolant temperature sensor, fuel temperature sensor, throttle position sensors, pedal position sensors, manifold pressure sensor, HEGO sensors, and intake air temperature sensor. Signals to these sensors are converted into digital counts by the SECM. A low/high range sensor fault is normally set when the converted digital counts reach the minimum of 0 or the maximum of 1024 (**1024 = 5.0 Vdc with ~ 204 counts per volt**).



Additionally, the SECM includes software to learn the actual range of the pedal position and throttle position sensors in order to take full advantage of the sensor range. Faults are set if the learned values are outside of the normal expected range of the sensor (e.g. APP1AdaptLoMin).

Table 1. Fault List Definitions

FAULT	DESCRIPTION	CODE (MI04 CODE)
APP1AdaptHiMax	Learned full pedal end of APP1 sensor range higher than expected	641 (64)
APP1AdaptHiMin	Learned full pedal end of APP1 sensor range lower than expected	651
APP1AdaptLoMax	Learned idle end of APP1 sensor range higher than expected	661
APP1AdaptLoMin	Learned idle end of APP1 sensor range lower than expected	631 (63)
APP1RangeHigh	APP1 sensor voltage out of range high, normally set if the APP1 signal has shorted to power or the ground for the sensor has opened	621 (62)
APP1RangeLow	APP1 sensor voltage out of range low, normally set if the APP1 signal has shorted to ground, circuit has opened or sensor has failed	611 (61)
APP2AdaptHiMax	Learned full pedal end of APP2 sensor range higher than expected	642 (68)

Table 1. Fault List Définitions (cont'd.)

FAULT	DESCRIPTION	CODE (MI04 CODE)
APP2AdaptHiMin	Learned full pedal end of APP2 sensor range lower than expected	652
APP2AdaptLoMax	Learned idle end of APP2 sensor range higher than expected	662
APP2AdaptLoMin	Learned idle end of APP2 sensor range lower than expected	632 (67)
APP2RangeHigh	APP2 sensor voltage out of range high, normally set if the APP2 signal has shorted to power or the ground for the sensor has opened	622 (66)
APP2RangeLow	APP2 sensor voltage out of range low, normally set if the APP2 signal has shorted to ground, circuit has opened or sensor has failed	612 (65)
APP_Sensors_Conflict	APP position sensors do no not track well, intermittent connections to APP or defective pedal assembly	691 (69)
CamEdgesFault	No CAM signal when engine is known to be rotating, broken CAM sensor leads or defective CAM sensor	191
CamSyncFault	Loss of synchronization on the CAM sensor, normally due to noise on the signal or an intermittent connection on the CAM sensor	192
CrankEdgesFault	No crankshaft signal when engine is known to be rotating, broken crankshaft sensor leads or defective crank sensor	193
CrankSyncFault	Loss of synchronization on the crankshaft sensor, normally due to noise on the signal or an intermittent connection on the crankshaft sensor	194
ECTOverTempFault	Engine Coolant Temperature is High. The sensor has measured an excessive coolant temperature typically due to the engine overheating.	161 (16)
ECTRangeHigh	Engine Coolant Temperature Sensor Input is High. Normally set if coolant sensor wire has been disconnected or circuit has opened to the SECM.	151 (15)

Table 1. Fault List Definitions (cont'd.)

FAULT	DESCRIPTION	CODE (MI04 CODE)
ECTRangeLow	Engine Coolant Temperature Sensor Input is Low. Normally set if the coolant sensor wire has shorted to chassis ground or the sensor has failed.	141 (14)
ECT_IR_Fault	Engine Coolant Temperature not changing as expected	171
EST1_Open	EST1 output open, possibly open EST1 signal or defective spark module	421 (42?)
EST1_Short	EST1 output shorted high or low, EST1 signal shorted to ground or power or defective spark module	431
EST2_Open	EST2 output open, possibly open EST2 signal or defective spark module	422
EST2_Short	EST2 output shorted high or low, EST2 signal shorted to ground or power or defective spark module	432
EST3_Open	EST3 output open, possibly open EST3 signal or defective spark module	423
EST3_Short	EST3 output shorted high or low, EST3 signal shorted to ground or power or defective spark module	433
EST4_Open	EST4 output open, possibly open EST4 signal or defective spark module	424
EST4_Short	EST4 output shorted high or low, EST4 signal shorted to ground or power or defective spark module	434
EST5_Open	EST5 output open, possibly open EST5 signal or defective spark module	425
EST5_Short	EST5 output shorted high or low, EST5 signal shorted to ground or power or defective spark module	435
EST6_Open	EST6 output open, possibly open EST6 signal or defective spark module	426
EST6_Short	EST6 output shorted high or low, EST6 signal shorted to ground or power or defective spark module	436
EST7_Open	EST7 output open, possibly open EST7 signal or defective spark module	427

Table 1. Fault List Definitions (cont'd.)

FAULT	DESCRIPTION	CODE (MI04 CODE)
EST7_Short	EST7 output shorted high or low, EST7 signal shorted to ground or power or defective spark module	437
EST8_Open	EST8 output open, possibly open EST8 signal or defective spark module	428
EST8_Short	EST8 output shorted high or low, EST8 signal shorted to ground or power or defective spark module	438
ETCSpringTest	Electronic Throttle Control Spring Return Test has Failed. The SECM will perform a safety test of the throttle return spring following engine shutdown. If this spring has become weak the throttle will fail the test and set the fault. **NOTE: Throttle assembly is not a serviceable item and can only be repaired by replacing the DV-EV throttle assembly**.	481 (28)
ETC_Open_Fault	Electronic Throttle Control Driver has failed. Normally set if either of the ETC driver signals have opened or become disconnected, electronic throttle or SECM is defective.	471
ETC_Sticking	Electronic Throttle Control is Sticking. This can occur if the throttle plate (butterfly valve) inside the throttle bore is sticking. The plate sticking can be due to some type of obstruction; a loose throttle plate or worn components shaft bearings. ***NOTE: Throttle assembly is not a serviceable item and can only be repaired by replacing the DV-EV throttle assembly.***	461 (26)
FuelSelectConflict	Conflict in fuel select signals, normally set if one or both of the fuel select signals are shorted to ground	181
FuelTempRangeHigh	Fuel Temperature Sensor Input is High. Normally set if the fuel temperature sensor wire has been disconnected or the circuit has opened to the SECM.	932

Table 1. Fault List Definitions (cont'd.)

FAULT	DESCRIPTION	CODE (MI04 CODE)
FuelTempRangeLow	Fuel Temperature Sensor Input is Low. Normally set if the fuel temperature sensor wire has shorted to chassis ground or the sensor has failed.	931
GasFuelAdaptRangeHi	In LPG mode, system had to adapt lean more than expected	731 (73)
GasFuelAdaptRangeLo	In LPG mode, system had to adapt rich more than expected	721 (72)
GasO2FailedLean	Pre-catalyst O2 sensor indicates extended lean operation on LPG	751
GasO2FailedRich	Pre-catalyst O2 sensor indicates extended rich operation on LPG	771 (77)
GasO2NotActive	Pre-catalyst O2 sensor inactive on LPG, open O2 sensor signal or heater leads, defective O2 sensor, or defective FTVs	741 (74)
GasPostO2FailedRich	Post-catalyst O2 sensor control on LPG has reached rich limit and sensor still reads to lean. This could be caused by oxygen leak before or just after sensor, catalyst failure, sensor failure, or wiring/relay failure causing the sensor to not be properly heated. If any Pre-O2 sensor faults are set, diagnose these first and after correcting these faults recheck if this fault sets.	772
GasPostO2FailedLean	Post-catalyst O2 sensor control on LPG has reached lean limit and sensor still reads to rich. This could be caused by catalyst failure, sensor failure, or wiring/relay failure causing the sensor to not be properly heated. If any Pre-O2 sensor faults are set diagnose, these first and after correcting these faults recheck if this fault sets.	752
GasPostO2Inactive	Post-catalyst O2 sensor control on LPG has sensed the O2 sensor is not responding as expected. If any Pre-O2 sensor faults are set diagnose these first and after correcting these faults recheck if this fault sets. Possible causes for this fault are sensor disconnected, sensor heater failed, sensor element failed, heater relay, or SECM control of heater relay is disconnected or failed.	742
Reserved for Future Use		743

Table 1. Fault List Definitions (cont'd.)

FAULT	DESCRIPTION	CODE (MI04 CODE)
HbridgeFault_ETC	(Electronic Throttle Control Driver has Failed) Indeterminate fault on Hbridge driver for Electronic Throttle Control. Possibly either ETC+ or ETC- driver signals have been shorted to ground	491 (29)
HardOverspeed	Engine speed has exceeded the third level (3 of 3) of overspeed protection	571 (57)
IATRangeHigh	Intake Air Temperature Sensor Input is High normally set if the IAT temperature sensor wire has been disconnected, the circuit has opened to the SECM, or a short to Vbatt has occurred.	381 (38)
IATRangeLow	Intake Air Temperature Sensor Input is Low normally set if the IAT temperature sensor wire has shorted to chassis ground or the sensor has failed.	371 (37)
IAT_IR_Fault	Intake Air Temperature not changing as expected	391
Inj1Open	Gasoline Injector 1 open circuit, broken injector 1 wire or defective injector	131
Inj2Open	Gasoline Injector 2 open circuit, broken injector 2 wire or defective injector	132
Inj3Open	Gasoline Injector 3 open circuit, broken injector 3 wire or defective injector	133
Inj4Open	Gasoline Injector 4 open circuit, broken injector 4 wire or defective injector	134
Inj5Open	Gasoline Injector 5 open circuit, broken injector 5 wire or defective injector	135
Inj6Open	Gasoline Injector 6 open circuit, broken injector 6 wire or defective injector	136
Inj7Open	Gasoline Injector 7 open circuit, broken injector 7 wire or defective injector	137
Inj8Open	Gasoline Injector 8 open circuit, broken injector 8 wire or defective injector	138
LSDFault_CSValve	Cold Start Valve Fault, signal has opened or shorted to ground or power or defective cold start valve	713

Table 1. Fault List Definitions (cont'd.)

FAULT	DESCRIPTION	CODE (MI04 CODE)
LSDFault_CheckEngine	Check Engine Lamp Fault, signal has opened or shorted to ground or power or defective check engine lamp	714
LSDFault_CrankDisable	Crank Disable Fault, signal has opened or shorted to ground or power or defective crank disable relay	715
LSDFault_Dither1	Dither Valve 1 Fault, signal has opened or shorted to ground or power or defective dither 1 valve	711 (71)
LSDFault_Dither2	Dither Valve 2 Fault, signal has opened or shorted to ground or power or defective dither 2 valve	712
LSDFault_FuelPump	Fuel Pump Fault, signal has opened or shorted to ground or power or defective fuel pump	716
LSDFault_LockOff	Fuel lock off Valve Fault, signal has opened or shorted to ground or power or defective Fuel lock off valve	717
LSDFault_MIL	Malfunction Indicator Lamp Fault, signal has opened or shorted to ground or power or defective MIL lamp	718
LiqFuelAdaptRangeHi	In Gasoline mode, system had to adapt rich more than expected	821
LiqFuelAdaptRangeLow	In Gasoline mode, system had to adapt lean more than expected	831
LiqO2FailedLean	Pre-catalyst O2 sensor indicates extended lean operation on gasoline	851
LiqO2FailedRich	Pre-catalyst O2 sensor indicates extended rich operation on gasoline	871
LiqO2NotActive	Pre-catalyst O2 sensor inactive on gasoline, open O2 sensor signal or heater leads, defective O2 sensor	841
LiqPostO2FailedRich	Post-catalyst O2 sensor control on gasoline has reached rich limit and sensor still reads to lean. This could be caused by oxygen leak before or just after sensor, catalyst failure, sensor failure, or wiring/relay failure causing the sensor to not be properly heated. If any Pre-O2 sensor faults are set, diagnose these first and after correcting these faults recheck if this fault sets.	872
LiqPostO2FailedLean	Post-catalyst O2 sensor control on gasoline has reached lean limit and sensor still reads to rich. This could be caused by catalyst failure, sensor failure, or wiring/relay failure causing the sensor to not be properly heated. If any Pre-O2 sensor faults are set, diagnose these first and after correcting these faults recheck if this fault sets.	852

Table 1. Fault List Definitions (cont'd.)

FAULT	DESCRIPTION	CODE (MI04 CODE)
LiqPostO2Inactive	Post-catalyst O2 sensor control on gasoline has sensed the O2 sensor is not responding as expected. If any Pre-O2 sensor faults are set, diagnose these first and after correcting these faults recheck if this fault sets. Possible causes for this fault are sensor disconnected, sensor heater failed, sensor element failed, heater relay, or SECM control of heater relay is disconnected or failed.	842
Reserved		843
LowOilPressureFault	Low engine oil pressure	521 (52)
MAPRangeHigh	Manifold Absolute Pressure Sensor Input is High, normally set if the TMAP pressure signal wire has become shorted to power, shorted to the IAT signal, the TMAP has failed or the SECM has failed.	342
MAPRangeLow	Manifold Absolute Pressure Sensor Input is Low, normally set if the TMAP pressure signal wire has been disconnected or shorted to ground or the circuit has opened to the SECM	332
MAPTimeRangeHigh	Manifold Absolute Pressure Sensor Input is High, normally set if the TMAP pressure signal wire has become shorted to power, shorted to the IAT signal, the TMAP has failed or the SECM has failed.	341 (34)
MAPTimeRangeLow	Manifold Absolute Pressure Sensor Input is Low, normally set if the TMAP pressure signal wire has been disconnected or shorted to ground or the circuit has opened to the SECM	331 (33)
MAP_IR_HI	MAP sensor indicates higher pressure than expected	351
MAP_IR_LO	MAP sensor indicates lower pressure than expected	352
MAP_STICKING	MAP sensor not changing as expected	353
MediumOverspeed	Engine speed has exceeded the second level (2 of 3) of overspeed protection	572
O2RangeHigh	Pre-catalyst O2 sensor voltage out of range high, sensor signal shorted to power	921
O2RangeLow	Pre-catalyst O2 sensor voltage out of range low, sensor signal shorted to ground	911
O2_PostCatRangeHigh	Post-catalyst O2 sensor voltage out of range high, sensor signal shorted to voltage source (5V or battery)	922
O2_PostCatRangeLow	Post-catalyst O2 sensor voltage out of range low, sensor signal shorted to ground	912
SensVoltRangeHigh	Sensor reference voltage XDRP too high	561 (56)

Table 1. Fault List Definitions (cont'd.)

FAULT	DESCRIPTION	CODE (MI04 CODE)
SensVoltRangeLow	Sensor reference voltage XDRP too low	551 (55)
ServiceFault1	Service Interval 1 has been reached	991
ServiceFault2	Service Interval 2 has been reached	992
ServiceFault3	Service Interval 3 has been reached	993
ServiceFault4	Service Interval 4 has been reached—time to replace HEGO sensors	994
ServiceFault5	Service Interval 5 has been reached—time to replace engine timing belt	995
SoftOverspeed	Engine speed has exceeded first level (1 of 3) of overspeed protection	573
TPS1AdaptHiMin	Learned WOT end of TPS1 sensor range lower than expected	271
SysVoltRangeHigh	System voltage too high	541 (54)
SysVoltRangeLow	System voltage too low	531 (53)
TPS1AdaptHiMax	Learned WOT end of TPS1 sensor range higher than expected	251 (25)
TPS1AdaptHiMin	Learned WOT end of TPS1 sensor range lower than expected	271
TPS1AdaptLoMax	Learned closed throttle end of TPS1 sensor range higher than expected	281
TPS1AdaptLoMin	Learned closed throttle end of TPS1 sensor range lower than expected	241 (24)
TPS1RangeHigh	TPS1 sensor voltage out of range high, normally set if the TPS1 signal has shorted to power or ground for the sensor has opened	231 (23)
TPS1RangeLow	TPS1 sensor voltage out of range low, normally set if TPS1 signal has shorted to ground, circuit has opened or sensor has failed	221 (22)
TPS2AdaptHiMax	Learned WOT end of TPS2 sensor range higher than expected	252
TPS2AdaptHiMin	Learned WOT end of TPS2 sensor range lower than expected	272
TPS2AdaptLoMax	Learned closed throttle end of TPS2 sensor range higher than expected	282
TPS2AdaptLoMin	Learned closed throttle end of TPS2 sensor range lower than expected	242
TPS2RangeHigh	TPS2 sensor voltage out of range high, normally set if the TPS2 signal has shorted to power or ground for the sensor has opened	232

Table 1. Fault List Definitions (cont'd.)

FAULT	DESCRIPTION	CODE (MI04 CODE)
TPS2RangeLow	TPS2 sensor voltage out of range low, normally set if TPS2 signal has shorted to ground, circuit has opened or sensor has failed	222
TPS_Sensors_Conflict	TPS sensors differ by more than expected amount. ***NOTE: The TPS is not a serviceable item and can only be repaired by replacing the DV-EV throttle assembly***	291
TransOilTemp	Excessive transmission oil temperature	933

Table 2. Diagnostic Fault Codes (Flash Codes)

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
12	**NONE** Signifies the end of one pass through the fault list	NONE	None, used as end of the fault list identification
131	**Inj1Open** Gasoline Injector 1 open circuit, broken injector 1 wire or defective injector	TurnOnMil	Check INJ1 wiring for an open circuit SECM (Signal) A5 to Injector 1 Pin A Switched 12V to Injector 1 Pin B Check Injector 1 Resistance, 12 to14 ohms (cold)
132	**Inj2Open** Gasoline Injector 2 open circuit, broken injector 2 wire or defective injector	TurnOnMil	Check INJ2 wiring for an open circuit SECM (Signal) A8 to Injector 2 Pin A Switched 12V to Injector 2 Pin B Check Injector 2 Resistance, 12 to14 ohms (cold)
133	**Inj3Open** Gasoline Injector 3 open circuit, broken injector 3 wire or defective injector	TurnOnMil	Check INJ3 wiring for an open circuit SECM (Signal) A4 to Injector 3 Pin A Switched 12V to Injector 3 Pin B Check Injector 3 Resistance, 12 to14 ohms (cold)
134	**Inj4Open** Gasoline Injector 4 open circuit, broken injector 4 wire or defective injector	TurnOnMil	Check INJ4 wiring for an open circuit SECM (Signal) A7 to Injector 4 Pin A Switched 12V to Injector 4 Pin B Check Injector 4 Resistance, 12 to 14 ohms (cold)
135 Not Used	**Inj5Open** Gasoline Injector 5 open circuit, broken injector 5 wire or defective injector	None	N/A
136 Not Used	**Inj6Open** Gasoline Injector 6 open circuit, broken injector 6 wire or defective injector	None	N/A
137 Not Used	**Inj7Open** Gasoline Injector 7 open circuit, broken injector 7 wire or defective injector	None	N/A
138 Not Used	**Inj8Open** Gasoline Injector 8 open circuit, broken injector 8 wire or defective injector	None	N/A
141 (14)	**ECTRangeLow** Coolant Sensor failure or shorted to GND	TurnOnMil	Check ECT sensor connector and wiring for a short to GND SECM (Signal) Pin B15 To ECT Pin 3 SECM (Sensor GND) Pin B1 to ECT Pin 1 SECM (System GND) Pin A16, B17
151 (15)	**ECTRangeHigh** Coolant sensor disconnected or open circuit	(1) TurnOnMil (2) DelayedEngine Shutdown (3) CheckEngineLight	Check if ECT sensor connector is disconnected or for an open ECT circuit SECM (Signal) Pin B15 to ECT Pin 3 SECM (Sensor GND) Pin B1 to ECT Pin 1

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
161 (16)	**ECTOverTempFault** Engine coolant temperature is high. The sensor has measured an excessive coolant temperature typically due to the engine overheating.	(1) TurnOnMil (2) DelayedEngine Shutdown (3) CheckEngineLight	Check coolant system for radiator blockage, proper coolant level and for leaks in the system. Possible ECT short to GND, check ECT signal wiring SECM (Signal) Pin B15 to ECT Pin 3 SECM (Sensor GND) Pin B1 to ECT Pin 1 SECM (System GND) Pin A16, B17 Check regulator for coolant leaks
171	**ECT_IR_Fault** Engine coolant temperature not changing as expected	None	Check for coolant system problems, e.g. defective or stuck thermostat
181	**FuelSelectConflict** Conflict in fuel select signals, normally set if both of the fuel select signals are shorted to ground	TurnOnMil	Check fuel select switch connection for a short to GND SECM (SIGNAL) Pin A12 SECM (SIGNAL) Pin A15 SECM (Sensor GND) Pin B1
191	**CamEdgesFault** No CAM signal when engine is known to be rotating, broken crankshaft sensor leads or defective CAM sensor	None	Check CAM sensor connections SECM (SIGNAL) Pin B10 to CAM sensor Pin 2 SECM (Sensor GND) Pin B1 to CAM sensor Pin 3 Switched 12V to CAM sensor Pin 1 Check for defective CAM sensor
192	**CamSyncFault** Loss of synchronization on the CAM sensor, normally due to noise on the signal or an intermittent connection on the CAM sensor	None	Check CAM sensor connections SECM (SIGNAL) Pin B10 to CAM sensor Pin 2 SECM (Sensor GND) Pin B1 to CAM sensor Pin 3 Switched 12V to CAM sensor Pin 1 Check for defective CAM sensor
193	**CrankEdgesFault** No crankshaft signal when engine is known to be rotating, broken crankshaft sensor leads or defective crank sensor	None	Check Crankshaft sensor connections SECM (SIGNAL) Pin B5 to Crank sensor Pin 3 SECM (Sensor GND) PIN B1 to Crank sensor Pin 2 Switched 12V to Crank sensor Pin 1 Check for defective Crank sensor
194	**CrankSyncFault** Loss of synchronization on the crankshaft sensor, normally due to noise on the signal or an intermittent connection on the crankshaft sensor	None	Check Crankshaft sensor connections SECM (SIGNAL) Pin B5 to Crank sensor Pin 3 SECM (Sensor GND) Pin B1 to Crank sensor Pin 2 Switched 12V to Crank sensor Pin 1 Check for defective Crank sensor

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
221 (22)	**TPS1RangeLow** TPS1 sensor voltage out of range low, normally set if the TPS1 signal has shorted to ground, circuit has opened or sensor has failed	TurnOnMil	Check throttle connector connection and TPS1 sensor for an open circuit or short to GND SECM Pin B23 (signal) to ETC Pin 6 SECM Pin B1 (sensor GND) to ETC Pin 2 SECM (system GND) Pin A16, B17
222	**TPS2RangeLow** TPS2 sensor voltage out of range low, normally set if the TPS2 signal has shorted to ground, circuit has opened or sensor has failed	TurnOnMil	Check throttle connector connection and TPS2 sensor for an open circuit or short to GND SECM Pin B4 (signal) to ETC Pin 5 SECM Pin B1 (sensor GND) to ETC Pin 2 SECM (system GND) Pin A16, B17
231 (23)	**TPS1RangeHigh** TPS1 sensor voltage out of range high, normally set if the TPS1 signal has shorted to power or the ground for the sensor has opened	TurnOnMil	Check throttle connector and TPS1 sensor wiring for a shorted circuit SECM Pin B23 (signal) to ETC Pin 6 SECM Pin B1 (sensor GND) to ETC Pin 2
232	**TPS2RangeHigh** TPS2 sensor voltage out of range high, normally set if the TPS2 signal has shorted to power or the ground for the sensor has opened	TurnOnMil	Check throttle connector and TPS1 sensor wiring for a shorted circuit SECM Pin B4 (signal) to ETC Pin 5 SECM pin B1 (sensor GND) to ETC Pin 2
241 (24)	**TPS1AdaptLoMin** Learned closed throttle end of TPS1 sensor range lower than expected	None	Check the throttle connector and pins for corrosion. To check the TPS disconnect the throttle connector and measure the resistance from: TPS Pin 2 (GND) to Pin 6 (TPS1 SIGNAL) (0.7 Ω ± 30%) TPS Pin 3 (PWR) to Pin 6 (TPS1 SIGNAL) (1.4 Ω ± 30%)
242	**TPS2AdaptLoMin** Learned closed throttle end of TPS2 sensor range lower than expected	None	Check the throttle connector and pins for corrosion. To check the TPS disconnect the throttle connector and measure the resistance from: TPS Pin 2 (GND) to Pin 5 (TPS2 SIGNAL) (1.3K Ω ± 30%) TPS PIN 3 (PWR) to PIN 5 (TPS2 SIGNAL) (0.6K Ω ± 30%)
251 (25)	**TPS1AdaptHiMax** Learned WOT end of TPS1 sensor range higher than expected	None	N/A
252	**TPS2AdaptHiMax** Learned WOT end of TPS2 sensor range higher than expected	None	N/A
271	**TPS1AdaptHiMin** Learned WOT end of TPS1 sensor range lower than expected	None	N/A

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
272	**TPS2AdaptHiMin** Learned WOT end of TPS2 sensor range lower than expected	None	N/A
281	**TPS1AdaptLoMax** Learned closed throttle end of TPS1 sensor range higher than expected	None	N/A
282	**TPS2AdaptLoMax** Learned closed throttle end of TPS2 sensor range higher than expected	None	N/A
291	**TPS_Sensors_Conflict** TPS sensors differ by more than expected amount **NOTE: *The TPS is not a serviceable item and can only be repaired by replacing the DV-EV throttle assembly.***	(1) TurnOnMil (2) Engine Shutdown	Perform checks for DFCs 241 & 242
331 (33)	**MAPTimeRangeLow** Manifold Absolute Pressure sensor input is low, normally set if the TMAP pressure signal wire has been disconnected or shorted to ground or the circuit has opened to the SECM	None	Check TMAP connector and MAP signal wiring for an open circuit TMAP Pin 4 to SECM Pin B18 (signal) TMAP Pin 1 to SECM Pin B1 (sensor GND) TMAP Pin 3 to SECM Pin B24 (XDRP +5 Vdc) Check the MAP sensor by disconnecting the TMAP connector and measuring at the sensor: TMAP Pin 1(GND) to Pin 4 (pressure signal KPA) (2.4kΩ - 8.2kΩ) TMAP Pin 3 (power) to Pin 4 (pressure signal KPA) (3.4kΩ - 8.2kΩ)

332	**MAPRangeLow** Manifold Absolute Pressure sensor input is low, normally set if the TMAP pressure signal wire has been disconnected or shorted to ground or the circuit has opened to the SECM	(1) TurnOnMil (2) CutThrottle	Check TMAP connector and MAP signal wiring for an open circuit TMAP Pin 4 to SECM Pin B18 (signal) TMAP Pin 1 to SECM Pin B1 (sensor GND) TMAP Pin 3 to SECM Pin B24 (XDRP +5 Vdc) Check the MAP sensor by disconnecting the TMAP connector and measuring at the sensor: TMAP Pin 1(GND) to Pin 4 (pressure signal KPA) (2.4kΩ - 8.2kΩ) TMAP Pin 3 (power) to Pin 4 (pressure signal KPA) (3.4kΩ - 8.2kΩ)

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
341 (34)	**MAPTimeRangeHigh** Manifold Absolute Pressure Sensor Input is High, normally set if the TMAP pressure signal wire has become shorted to power, shorted to the IAT signal, the TMAP has failed or the SECM has failed.	None	Check TMAP connector and MAP signal wiring for a shorted circuit TMAP Pin 4 to SECM Pin B18 (signal) TMAP Pin 1 to SECM Pin B1 (sensor GND) TMAP Pin 3 to SECM Pin B24 (XDRP +5 Vdc) Check the MAP sensor by disconnecting the TMAP connector and measuring at the sensor: TMAP Pin 1(GND) to Pin 4 (pressure signal KPA) (2.4kΩ - 8.2kΩ) TMAP Pin 3 (power) to Pin 4 (pressure signal KPA) (3.4kΩ - 8.2kΩ)
342	**MAPRangeHigh** Manifold Absolute Pressure Sensor Input is High, normally set if the TMAP pressure signal wire has become shorted to power, shorted to the IAT signal, the TMAP has failed or the SECM has failed	(1) TurnOnMil (2) CutThrottle	Check TMAP connector and MAP signal wiring for a shorted circuit TMAP Pin 4 to SECM Pin B18 (signal) TMAP Pin 1 to SECM Pin B1 (sensor GND) TMAP Pin 3 to SECM Pin B24 (XDRP +5 Vdc) Check the MAP sensor by disconnecting the TMAP connector and measuring at the sensor: TMAP Pin 1(GND) to Pin 4 (pressure signal KPA) (2.4kΩ - 8.2kΩ) TMAP Pin 3 (power) to Pin 4 (pressure signal KPA) (3.4kΩ - 8.2kΩ)
351	**MAP_IR_HI** MAP sensor indicates higher pressure than expected	None	Check for vacuum leaks. Check that TMAP sensor is mounted properly. Possible defective TMAP sensor.
352	**MAP_IR_LO** MAP sensor indicates lower pressure than expected	None	Possible defective TMAP sensor.

353	**MAP_STICKING** MAP sensor not changing as expected	None	Check that TMAP sensor is mounted properly. Possible defective TMAP sensor.
371 (37)	**IATRangeLow** Intake Air Temperature Sensor Input is Low normally set if the IAT temperature sensor wire has shorted to chassis ground or the sensor has failed.	TurnOnMil	Check TMAP connector and IAT signal wiring for a shorted circuit TMAP Pin 2 to SECM Pin B12 (signal) TMAP Pin 1 to SECM Pin B1 (sensor GND) To check the IAT sensor of the TMAP disconnect the TMAP connector and measure the IAT resistance Resistance is approx 2400 ohms at room temperature.

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION, FIRST CHECK
381 (38)	**IATRangeHigh** Intake Air Temperature Sensor Input is High normally set if the IAT temperature sensor wire has been disconnected or the circuit has opened to the SECM.	TurnOnMil	Check TMAP connector and IAT signal wiring for a shorted circuit TMAP Pin 2 to SECM Pin B12 (signal) TMAP Pin 1 to SECM Pin B1 (sensor GND) To check the IAT sensor of the TMAP disconnect the TMAP connector and measure the IAT resistance Resistance is approx 2400 ohms at room temperature.
391	**IAT_IR_Fault** Intake Air Temperature not changing as expected	None	Check connections to TMAP sensor. Check that TMAP sensor is properly mounted to manifold.
421	**EST1_Open** EST1 output open, possibly open EST1 signal or defective spark module	TurnOnMil	Check coil driver wiring and connector for open circuit SECM Pin A9 (EST1) to OEM ignition system. See application note. Verify GND on ignition module Pin A (of both connectors) Verify +12 Vdc on ignition module Pin B (of both connectors) Refer to application manual for specific engine details.

422	**EST2_Open** EST2 output open, possibly open EST2 signal or defective spark module	TurnOnMil	Check coil driver wiring and connector for open circuit SECM Pin A10 (EST2) to OEM ignition system. See application note. Verify GND on ignition module Pin A (of both connectors) Verify +12 Vdc on ignition module Pin B (of both connectors) Refer to application manual for specific engine details.
423	**EST3_Open** EST3 output open, possibly open EST3 signal or defective spark module	TurnOnMil	Check coil driver wiring and connector for open circuit SECM Pin A3 (EST3) to OEM ignition system. See application note. Verify GND on ignition module Pin A (of both connectors) Verify +12 Vdc on ignition module Pin B (of both connectors) Refer to application manual for specific engine details.

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
424	**EST4_Open** EST4 output open, possibly open EST4 signal or defective spark module	TurnOnMil	Check coil driver wiring and connector for open circuit SECM Pin A6 (EST4) to OEM ignition system. See application manual. Verify GND on ignition module Pin A (of both connectors) Verify +12 Vdc on ignition module Pin B (of both connectors) Refer to application manual for specific engine details.
425	**EST5_Open** EST5 output open, possibly open EST5 signal or defective spark module	None	N/A
426	**EST6_Open** EST6 output open, possibly open EST6 signal or defective spark module	None	N/A
427	**EST7_Open** EST7 output open, possibly open EST7 signal or defective spark module	None	N/A
428	**EST8_Open** EST8 output open, possibly open EST8 signal or defective spark module	None	N/A

431	**EST1_Short** EST1 output shorted high or low, EST1 signal shorted to ground or power or defective spark module	TurnOnMil	Check coil driver wiring and connector for shorts SECM Pin A9 (EST1) to ignition module Pin D (4-pin connector) Verify GND on ignition module Pin A (of both connectors) Verify +12 Vdc on ignition module Pin B (of both connectors) Refer to application manual for specific engine details.

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
432	**EST2_Short** EST2 output shorted high or low, EST2 signal shorted to ground or power or defective spark module	TurnOnMil	Check coil driver wiring and connector for shorts SECM Pin A10 (EST2) to ignition module Pin D (4-pin connector) Verify GND on ignition module Pin A (of both connectors) Verify +12 Vdc on ignition module Pin B (of both connectors) Refer to application manual for specific engine details.
433	**EST3_Short** EST3 output shorted high or low, EST3 signal shorted to ground or power or defective spark module	TurnOnMil	Check coil driver wiring and connector for shorts SECM Pin A3 (EST3) to ignition module Pin D (4-pin connector) Verify GND on ignition module Pin A (of both connectors) Verify +12 Vdc on ignition module Pin B (of both connectors) Refer to application manual for specific engine details.
434	**EST4_Short** EST4 output shorted high or low, EST4 signal shorted to ground or power or defective spark module	TurnOnMil	Check coil driver wiring and connector for shorts SECM Pin A6 (EST4) to ignition module Pin D (4-pin connector) Verify GND on ignition module Pin A (of both connectors) Verify +12 Vdc on ignition module Pin B (of both connectors) Refer to application manual for specific engine details.
435	**EST5_Short** EST5 output shorted high or low, EST5 signal shorted to ground or power or defective spark module	None	N/A
436	**EST6_Short** EST6 output shorted high or low, EST6 signal shorted to ground or power or defective spark module	None	N/A

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
437	**EST7_Short** EST7 output shorted high or low, EST7 signal shorted to ground or power or defective spark module	None	N/A
438	**EST8_Short** EST8 output shorted high or low, EST8 signal shorted to ground or power or defective spark module	None	N/A
461 (26)	**ETC_Sticking** Electronic Throttle Control is sticking. This can occur if the throttle plate (butterfly valve) inside the throttle bore is sticking. The plate sticking can be due to some type of obstruction, a loose throttle plate, or worn components shaft bearings. **NOTE:** ***The throttle assembly is not a serviceable item and can only be repaired by replacing the DV-EV throttle assembly.***	(1) TurnOnMil (2) EngineShutdown (3) CutThrottle	Check for debris or obstructions inside the throttle body • Perform the throttle test using the Service Tool and re-check for fault • Check throttle-plate shaft for bearing wear Check the ETC driver wiring for an open circuit SECM Pin A17 to ETC + Pin 1 SECM Pin A18 to ETC - Pin 4 Check the ETC internal motor drive by disconnecting the throttle connector and measuring the motor drive resistance at the throttle TPS Pin 1 (+DRIVER) to Pin 4 (-DRIVER) ~3.0-4.0Ω
471	**ETC_Open_Fault** Electronic Throttle Control Driver has failed, normally set if either of the ETC driver signals have opened or become disconnected, electronic throttle or SECM is defective.	None	Check the ETC driver wiring for an open circuit SECM Pin A17 to ETC + Pin 1 SECM Pin A18 to ETC - Pin 4 Check the ETC internal motor drive by disconnecting the throttle connector and measuring the motor drive resistance at the throttle TPS Pin 1 (+DRIVER) to Pin 4 (-DRIVER) ~3.0-4.0Ω
481 (28)	**ETCSpringTest** Electronic Throttle Control Spring Return Test has failed. The SECM will perform a safety test of the throttle return spring following engine shutdown. If this spring has become weak the throttle will fail the test and set the fault. ***NOTE: The throttle assembly is not a serviceable item and can only be repaired by replacing the DV-EV throttle assembly.***	(1) TurnOnMil (2) EngineShutdown	Perform throttle spring test by cycling the ignition key and re-check for fault

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
491 (29)	**HbridgeFault_ETC** Electronic Throttle Control Driver has failed. Indeterminate fault on Hbridge driver for electronic throttle control. Possibly either ETC+ or ETC- driver signals have been shorted to ground	TurnOnMil	Check ETC driver wiring for a shorted circuit SECM Pin A17 to ETC + Pin 1 SECM Pin A18 to ETC - Pin 4 • Perform the throttle test using the Service Tool and re-check for fault Check the ETC internal motor drive by disconnecting the throttle connector and measuring the motor drive resistance at the throttle TPS Pin 1 (+DRIVER) to Pin 4 (-DRIVER) ~3.0-4.0Ω
521 (52)	**LowOilPressureFault** Low engine oil pressure	(1) TurnOnMil (2) DelayedEngine Shutdown (3) CheckEngine Light	Check engine oil level Check electrical connection to the oil pressure switch SECM Pin B9 to Oil Pressure Switch
531 (53)	**SysVoltRangeLow** System voltage too low	TurnOnMil	Check battery voltage • Perform maintenance check on electrical connections to the battery and chassis ground • Check battery voltage during starting and with the engine running to verify charging system and alternator function • Measure battery power at SECM with a multimeter (with key on) SECM Pin A23 (DRVP) to SECM Pin A16 (DRVG) SECM Pin A23 (DRVP) to SECM Pin B17 (DRVG)
541 (54)	**SysVoltRangeHigh** System voltage too high	TurnOnMil	Check battery and charging system voltage • Check battery voltage during starting and with the engine running • Check voltage regulator, alternator, and charging system • Check battery and wiring for overheating and damage • Measure battery power at SECM with a multimeter (with key on) SECM Pin A23 (DRVP) to SECM Pin A16 (DRVG) SECM Pin A23 (DRVP) to SECM Pin B17 (DRVG)

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
551 (55)	**SensVoltRangeLow** Sensor reference voltage XDRP too low	(1) TurnOnMil (2) EngineShutdown	Measure transducer power at the TMAP connector with a multimeter TMAP Pin 3 XDRP +5 Vdc to TMAP Pin 1 XDRG GND Verify transducer power at the SECM with a multimeter SECM Pin B24 +5 Vdc to SECM Pin B1 XDRG GND Verify transducer power at ETC with a multimeter ETC Pin 3 XDRP PWR to ETC Pin 2 XDRG GND Verify transducer power to the foot pedal with a multimeter.
561 (56)	**SensVoltRangeHigh** Sensor reference voltage XDRP too high	(1) TurnOnMil (2) EngineShutdown	Measure transducer power at the TMAP connector with a multimeter TMAP Pin 3 XDRP +5 Vdc to TMAP Pin 1 XDRG GND Verify transducer power at the SECM with a multimeter SECM Pin B24 +5 Vdc to SECM Pin B1 XDRG GND Verify transducer power at ETC with a multimeter ETC Pin 3 XDRP PWR to ETC Pin 2 XDRG GND Verify transducer power to the foot pedal with a multimeter.
571 (57)	**HardOverspeed** Engine speed has exceeded the third level (3 of 3) of overspeed protection	(1) TurnOnMil (2) HardRevLimit	Usually associated with additional ETC faults • Check for ETC Sticking or other ETC faults Verify if the lift truck was motored down a steep grade
572	**MediumOverspeed** Engine speed has exceeded the second level (2 of 3) of overspeed protection	(1) TurnOnMil (2) MediumRevLimit	Usually associated with additional ETC faults • Check for ETC Sticking or other ETC faults Verify if the lift truck was motored down a steep grade
573	**SoftOverspeed** Engine speed has exceeded the first level (1 of 3) of overspeed protection	(1) TurnOnMil (2) SoftRevLimit	Usually associated with additional ETC faults • Check for ETC Sticking or other ETC faults Verify if the lift truck was motored down a steep grade
611 (61)	**APP1RangeLow** APP1 sensor voltage out of range low, normally set if the APP1 signal has shorted to ground, circuit has opened or sensor has failed	(1) TurnOnMil (2) CheckEngineLight	Check foot pedal connector • Check APP1 signal at SECM PIN B7

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
612 (65**)**	**APP2RangeLow** APP2 sensor voltage out of range low, normally set if the APP2 signal has shorted to ground, circuit has opened or sensor has failed	TurnOnMil	Check foot pedal connector • Check APP2 signal at SECM PIN B16
621 (62)	**APP1RangeHigh** APP1 sensor voltage out of range high, normally set if the APP1 signal has shorted to power or the ground for the sensor has opened	1) TurnOnMil (2) CheckEngine Light	Check foot pedal connector • Check APP1 signal at SECM PIN B7
622 (66)	**APP2RangeHigh** APP2 sensor voltage out of range high, normally set if the APP2 signal has shorted to power or the ground for the sensor has opened	TurnOnMil	Check foot pedal connector • Check APP2 signal at SECM PIN B16
631 (63)	**APP1AdaptLoMin** Learned idle end of APP1 sensor range lower than expected	None	Check APP connector and pins for corrosion • Cycle the pedal several times and check APP1 signal at SECM Pin B7
632 (67)	**APP2AdaptLoMin** Learned idle end of APP2 sensor range lower than expected	None	Check APP connector and pins for corrosion • Cycle the pedal several times and check APP2 signal at SECM Pin B16
641 (64)	**APP1AdaptHiMax** Learned full pedal end of APP1 sensor range higher than expected	None	N/A
642 (68)	**APP2AdaptHiMax** Learned full pedal end of APP2 sensor range higher than expected	None	N/A
651	**APP1AdaptHiMin** Learned full pedal end of APP1 sensor range lower than expected	None	N/A
652	**APP2AdaptHiMin** Learned full pedal end of APP2 sensor range lower than expected	None	N/A
661	**APP1AdaptLoMax** Learned idle end of APP1 sensor range higher than expected	None	N/A
662	**APP2AdaptLoMax** Learned idle end of APP2 sensor range higher than expected	None	N/A
691 (69)	**APP_Sensors_Conflict** APP position sensors do no not track well, intermittent connections to APP or defective pedal assembly	1) TurnOnMil (2) Level1PowerLimit	Check APP connector and pins for corrosion • Cycle the pedal several times and check APP1 signal at SECM Pin B7 • Cycle the pedal several times and check APP2 signal at SECM Pin B16

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
711 (71)	**LSDFault_Dither1** Dither Valve 1 Fault, signal has opened or shorted to ground or power or defective dither 1 valve	TurnOnMil	Check FTV1 for an open wire or FTV connector being disconnected FTV1 Pin 1 (signal) to SECM Pin A1 FTV1 Pin 2 (power) to SECM (DRVP) Pin A23 Check FTV1 for an open coil by disconnecting the FTV connector and measuring the resistance (~26Ω ± 2Ω)
712	**LSDFault_Dither2** Dither Valve 2 Fault, signal has opened or shorted to ground or power or defective dither 2 valve	TurnOnMil	Check FTV1 for an open wire or FTV connector being disconnected or signal shorted to GND FTV2 Pin 1 (signal) to SECM Pin A2 FTV2 Pin 2 (power) to SECM (DRVP) Pin A23 Check FTV1 for an open coil by disconnecting the FTV connector and measuring the resistance (~26Ω ± 2Ω)
714	**LSDFault_CheckEngine** Check Engine Lamp Fault, signal has opened or shorted to ground or power or defective check engine lamp	None	Check 'Check Engine Lamp' for an open wire or shorted to GND
715	**LSDFault_CrankDisable** Crank Disable Fault, signal has opened or shorted to ground or power or defective crank disable relay	None	N/A
717	**LSDFault_LockOff** Fuel lock off Valve Fault, signal has opened or shorted to ground or power or defective Fuel lock off valve	TurnOnMil	Check fuel lock off valve for an open wire or connector being disconnected or signal shorted to GND Lockoff Pin B (signal) to SECM Pin A11 Lockoff Pin A (power) to SECM (DRVP) Pin A23 Check CSV for an open coil by disconnecting the CSV connector and measuring the resistance (~26Ω ± 3Ω)
718	**LSDFault_MIL** Malfunction Indicator Lamp Fault, signal has opened or shorted to ground or power or defective MIL lamp	None	Check MIL lamp for an open wire or short to GND.
721 (72)	**GasFuelAdaptRangeLo** In LPG mode, system had to adapt rich more than expected	TurnOnMil	Check for vacuum leaks. Check fuel trim valves, e.g. leaking valve or hose Check for missing orifice(s).

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
731 (73)	**GasFuelAdaptRangeHi** In LPG mode, system had to adapt lean more than expected	TurnOnMil	Check fuel trim valves, e.g. plugged valve or hose. Check for plugged orifice(s).
741 (74)	**GasO2NotActive** Pre-catalyst O2 sensor inactive on LPG, open O2 sensor signal or heater leads, defective O2 sensor	(1) TurnOnMil (2) DisableGas O2Ctrl	Check that Pre-catalyst O2 sensor connections are OK. O2 (signal) Pin 3 to SECM Pin B13 O2 Pin 2 (HEATER GND) to SECM (DRVG GNG) Pins A16, B17 O2 Pin 1 (HEATER PWR) to SECM (DRVP + 12V) Pin A23 Verify O2 sensor heater circuit is operating by measuring heater resistance (2.1Ω ± 0.4Ω) O2 Pin 2 (HEATER GND) to Pin 1 (HEATER PWR)
742	**GasPostO2NotActive** Post-catalyst O2 sensor inactive on LPG, open O2 sensor signal or heater leads, defective O2 sensor.	(1) TurnOnMil (2) DisableGasPost O2Ctrl	Check that Post-catalyst O2 sensor connections are OK. O2 (signal) Pin 3 to SECM Pin B19 O2 Pin 2 (HEATER GND) to SECM (DRVG GNG) Pins A16, B17 O2 Pin 1 (HEATER PWR) to Post O2 Heater Relay. Relay pin 87. This relay only turns on after engine has been running for some time and SECM has calculated that water condensation in exhaust has been removed by exhaust heat. Post O2 Heater Relay has SECM (DRVP + 12V) applied to the relay coil power. The relay coil ground is controlled by SECM Pin A20 to activate the relay to flow current through the post O2 heater. Verify O2 sensor heater circuit is operating by measuring heater resistance (2.1Ω ± 0.4Ω) O2 Pin 2 (HEATER GND) to Pin 1 (HEATER PWR)
743	**Reserved**		
751	**GasO2FailedLean** Pre-catalyst O2 sensor indicates extended lean operation on LPG	(1) TurnOnMil (2) DisableGas O2Ctrl	Check for vacuum leaks. Check fuel trim valves, e.g. leaking valve or hose. Check for missing orifice(s).

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
752	**GasPostO2FailedLean** Pre-catalyst O2 sensor indicates extended lean operation on LPG	(1) TurnOnMil (2) DisableGasPost O2Ctrl	Correct other faults that may contribute to 752 (e.g. faults pertaining to dither valves, Pre-Cat O2, Post Cat O2 sensor) Check for vacuum leaks Check for leaks in exhaust, catalytic converter, HEGO sensors; repair leaks. Check all sensor connections (see fault 742 corrective actions).
771 (77)	**GasO2FailedRich** Pre-catalyst O2 sensor indicates extended rich operation on LPG	(1) TurnOnMil (2) DisableGas O2Ctrl	Check fuel trim valves, e.g. plugged valve or hose. Check for plugged orifice(s).
772	**GasPostO2FailedRich** Pre-catalyst O2 sensor indicates extended rich operation on LPG	(1) TurnOnMil (2) DisableGasPostO 2Ctrl	Correct other faults that may contribute to 772 (e.g. faults pertaining to FTVs, Pre-Cat O2, Post Cat O2 sensor) Look for leaks in exhaust, catalytic converter, HEGO sensors; repair leaks. Check all sensor connections (see fault 742 corrective actions).
821	**LiqFuelAdaptRangeHi** In Gasoline mode, system had to adapt lean more than expected	TurnOnMil	Check for vacuum leaks. Low gasoline fuel pressure, perform gasoline pressure test. Injector problems, e.g. plugged, defective injector.
831	**LiqFuelAdaptRangeLow** In Gasoline mode, system had to adapt rich more than expected	TurnOnMil	Low gasoline fuel pressure, perform gasoline pressure test Injector problems, e.g. leaking, defective injector.
841	**LiqO2NotActive** Pre-catalyst O2 sensor inactive on gasoline, open O2 sensor signal or heater leads, defective O2 sensor	(1) TurnOnMil (2) DisableLiquid O2Ctrl	Check that Pre-catalyst O2 sensor connections are OK. O2 (signal) Pin 3 to SECM Pin B13 O2 Pin 2 (HEATER GND) to SECM (DRVG GNG) Pins A16, B17 O2 Pin 1 (HEATER PWR) to SECM (DRVP + 12V) PIN A23 Verify O2 sensor heater circuit is operating by measuring heater resistance (2.1Ω ± 0.4Ω) O2 Pin 2 (HEATER GND) to Pin 1 (HEATER PWR)

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
842	**LiqPostO2NotActive** Post-catalyst O2 sensor inactive on gasoline, open O2 sensor signal or heater leads, defective O2 sensor.	(1) TurnOnMil (2) DisableLiqPost O2Ctrl	Check that Post-catalyst O2 sensor connections are OK. O2 (return) Pin 4 to SECM Pin B1 O2 Pin 2 (HEATER GND) to SECM (DRVG GNG) Pins A16, B17 O2 Pin 1 (HEATER PWR) to Post O2 Heater Relay. Relay pin 87. This relay only turns on after engine has been running for some time and SECM has calculated that water condensation in exhaust has been removed by exhaust heat. Post O2 Heater Relay has SECM (DRVP + 12V) applied to the relay coil power. The relay coil ground is controlled by SECM Pin A20 to activate the relay to flow current through the post O2 heater. Verify O2 sensor heater circuit is operating by measuring heater resistance (2.1Ω ± 0.4Ω) O2 Pin 2 (HEATER GND) to Pin 1 (HEATER PWR)
843	Reserved		
851	**LiqO2FailedLean** Pre-catalyst O2 sensor indicates extended lean operation on gasoline	(1) TurnOnMil (2) DisableLiquid O2Ctrl	Check for vacuum leaks. Low gasoline fuel pressure, perform gasoline pressure test. Injector problems, e.g. plugged, defective injector
852	**LiqPostO2FailedLean** Pre-catalyst O2 sensor indicates extended lean operation on gasoline	(1) TurnOnMil (2) DisableLiqPost O2Ctrl	Correct other faults that may contribute to 852 (e.g. faults pertaining to Injectors, MAP, IAT, Pre-Cat O2, Post Cat O2 sensor. Look for leaks in exhaust, catalytic converter, HEGO sensors; repair leaks. Check all sensor connections (see fault 842 corrective actions).
871	**LiqO2FailedRich** Pre-catalyst O2 sensor indicates extended rich operation on gasoline	(1) TurnOnMil (2) DisableLiquid O2Ctrl	High gasoline fuel pressure, perform gasoline pressure test Injector problems, e.g. leaking, defective injector
872	**LiqPostO2FailedRich** Pre-catalyst O2 sensor indicates extended rich operation on gasoline	(1) TurnOnMil (2) DisableLiqPostO 2Ctrl	Correct other faults that may contribute to 872 (e.g. faults pertaining to Injectors, MAP, IAT, Pre-Cat O2, Post Cat O2 sensor. Look for leaks in exhaust, catalytic converter, HEGO sensors; repair leaks. Check all sensor connections (see fault 842 corrective actions).

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
911	**O2RangeLow** Pre-catalyst O2 sensor voltage out of range low, sensor signal shorted to ground	(1) TurnOnMil (2) DisableLiquid O2Ctrl (3) DisableGas O2Ctrl	Check if O2 sensor installed before the catalyst is shorted to GND or sensor GND. O2 (signal) Pin 3 to SECM Pin B13 SECM (DRVG GND) Pins A16, B17 SECM (XDRG sensor GND) Pin B1
912	**O2_PostCatRangeLow** Post-catalyst O2 sensor voltage out of range low, sensor signal shorted to ground	(1) TurnOnMil (2) Disable Gasoline Post-catalyst O2Ctrl (3) Disable LPG Post-catalyst O2Ctrl	Check if O2 installed after the catalyst sensor is shorted to GND or sensor GND. O2 (signal) Pin 3 to SECM Pin B19 Possible sources: SECM (DRVG GND) Pins A16, B17 and SECM (XDRG sensor GND) Pin B1
921	**O2RangeHigh** Pre-catalyst O2 sensor voltage out of range high, sensor signal shorted to power	(1) TurnOnMil (2) DisableLiquid O2Ctrl (3) DisableGas O2Ctrl	Check if O2 sensor installed before catalyst is shorted to +5Vdc or battery. O2 (signal) Pin 3 to SECM Pin B13 SECM (XDRP + 5V) Pin B24 SECM (DRVP + 12V) Pin A23
922	**O2_PostCatRangeHigh** Post-catalyst O2 sensor voltage out of range low, sensor signal shorted to ground	(1) TurnOnMil (2) Disable Gasoline Post-catalyst O2Ctrl (3) Disable LPG Post-catalyst O2Ctrl	Check if O2 sensor installed after catalyst is shorted to +5Vdc or battery. O2 (signal) Pin 3 to SECM Pin B19 Possible voltage sources: SECM (XDRP + 5V) Pin B24 and SECM (DRVP + 12V) Pin A23
931	**FuelTempRangeLow** Fuel Temperature Sensor Input is Low normally set if the fuel temperature sensor wire has shorted to chassis ground or the sensor has failed.	TurnOnMil	Check fuel temp sensor connector and wiring for a short to GND SECM (signal) Pin B14 to FTS Pin 1 SECM (sensor GND) Pin B1 to FTS Pin 2 SECM (system GND) Pin A16, B17
932	**FuelTempRangeHigh** Fuel Temperature Sensor Input is High normally set if the fuel temperature sensor wire has been disconnected or the circuit has opened to the SECM.	TurnOnMil	Check if fuel temp sensor connector is disconnected or for an open FTS circuit SECM (signal) Pin B14 to FTS Pin 1 SECM (sensor GND) Pin B1 to FTS Pin 2

(*) Fault actions shown are default values specified by the OEM.

Table 2. Diagnostic Fault Codes (Flash Codes) cont'd.

DFC	PROBABLE FAULT	FAULT ACTION *	CORRECTIVE ACTION FIRST CHECK
933	**TransOilTemp** Excessive transmission oil temperature	(1) TurnOnMil (2) Delayed EngineShutdown	Refer to drivetrain manufacturer's transmission service procedures.
991	**ServiceFault1** Service Interval 1 has been reached	None	Perform service procedure related to Service Interval 1 (determined by OEM)
992	**ServiceFault2** Service Interval 2 has been reached	None	Perform service procedure related to Service Interval 2 (determined by OEM)
993	**ServiceFault3** Service Interval 3 has been reached	None	Perform service procedure related to Service Interval 3 (determined by OEM)
994	**ServiceFault4** Service Interval 4 has been reached—replace HEGO sensors	TurnOnMil	Replace Pre-catalyst HEGO sensor Replace Post-catalyst HEGO sensor
995	**ServiceFault5** Service Interval 5 has been reached—replace timing belt	TurnOnMil	Replace engine timing belt

(*) Fault actions shown are default values specified by the OEM.

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WOODWARD

PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

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